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A NEW JOURNEY IN SOUTHERN ARABIA

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FROM OCTOBER 1945 until the end of February 1946 I travelled through the southern Rub el Khali [1] from Salala to Mughshin, north-east across the Sahma sands, and from Salala to Tarim in the wadi Hadhramaut. These journeys were undertaken for the Middle East Anti-Locust Mission in order to investigate locust breeding, seasonal rainfall, and vegetation.

I arrived at Salala on October 13. Messengers were at once sent out by the Wali to the Bedu beyond the mountains for camels and guides whilst I travelled in the interesting and little-known Jebel Qarra, where the wadis which flow down to Mughshin rise. This mountain range is 6 miles from Salala across the bare open plain of Jerbib. Between 2000 and 3000 feet high, Jebel Qarra is flanked on the west by Jebel Qamar and on the east by Jebel Samhan, mountains rising to over 7000 feet, which close in on the sea at Risut and Murbat and concentrate the rains onto its southern slopes. This mountain, covered by mist and rain throughout the season of the monsoon, has in consequence a tropical vegetation, unique in Arabia, whereas Qamar and Samhan are barren in contrast. Its southern face is cleft by successive, deep, sheer-sided gorges, filled with a jungle of deciduous trees, while the summit of the range consists of grassy downland which extends down the spurs between the valleys. Scattered over the downs are large ficus trees, growing singly or in small groups, and along the crest are occasional groves of wild olive and "tishga" shrubs. In October these downs are covered with a wild parsley, growing amid the waving green grass, but these soon wither for there is only a thin covering of soil above the limestone rock. Water is scarce and the few small springs are in the valley bottoms, difficult of access from the downs above. Streams from two of these springs flow across the plain down to the sea. The monsoon only strikes the southern face of the mountain, and the contrast between the two sides is extreme, a clear-cut line between the

[1] The English transliterations of Arabic names and words in the paper and on the map (following p. 288) are the author's, and no attempt has been made to reduce them to R.G.S. II form.—*Ed. G.J.*

downs and the desert, following the length of the watershed. To the south the rolling downs and jungle-filled gorges stretch down to the plain of Dhofar and the palm-fringed shores of the Indian Ocean, while to the north the lifeless gravel slopes and rock-bound precipices fall away to the emptiness of the Rub el Khali.

Jebel Qarra and the two adjoining mountains of Samhan and Qamar are mainly inhabited by the Qarra, an interesting and little-known people speaking a language of their own. Totally unlike the Bedu of the Empty Quarter, their features are yet in my opinion Semitic rather than Hamitic. They represent, with the numerous and powerful Mahra, the remnants of the Shahra and a few other broken tribes, the original inhabitants of southern Arabia before the Arabic-speaking tribes came south. The Qarra are divided into a number of clans.[1] Living in their different valleys, between which communication is only possible along the summit or at the foot of the mountain, these clans are jealous, suspicious, and divided among themselves by numerous blood feuds. They have an evil reputation for murder, treachery, and theft, priding themselves indeed on their skill in stealing and scorning the law of sanctuary. A pastoral people, their lives centre round their herds of cattle, which are however not large, a man of average wealth possessing twenty to thirty beasts. They own some camels and fair-sized flocks of goats, but no sheep, horses, nor dogs, for these are not to be found in this part of Arabia. They move up and down the mountain side according to the season and the pasturage. When the rains are over in September they graze their cattle in small family groups upon the downs, but by January they have collected at the valley mouths in large cattle camps, temporary villages of small, close crowded, grass shelters. During the monsoon they withdraw into the valleys, and shelter their cattle in caves in the limestone cliffs, or in low dark byres of which the walls are of rough stones and the roofs of matted grass. When the grazing is exhausted they feed the cattle, goats, and camels on dried sardines bought in Salala market with money from the sale of butter and firewood. They cultivate a few small patches of beans and a little sorghum in the valleys. In height the men average about 5 feet 4 inches, but they are of good physique and possess great powers of endurance. They dress in a length of cloth, generally indigo dyed, which is wrapped round the waist with an end thrown over the left shoulder, and they wind a plaited leather thong four or five times round their heads. Boys as yet uncircumcized [2] sometimes have their hair shaven on both sides to leave a cockscomb. Many of them wear 'Omani daggers and carry rifles, generally Martinis. Their other weapons are straight-bladed swords and

[1] The clans of the Qarra are from east to west: in Jebel Samhan, Beit el Mukheir; in Jebel Qarra: Beit el Masheni, Beit Jabub, Beit Kushob, Beit Halot, Beit Itbok, Beit Qatan (above Wadi Nihaz), Beit Baram, Beit Said; in Jebel Qamar: Beit Essa (consisting of Beit Aqaq, Beit Hardan, Beit Shimasa), Beit Tobaqi, Beit Gij'aul, Beit Thimos. Some El Kethir live between the Beit Qatan and Beit Baram.

[2] The Qarra and also the Beit Kethir circumcize at about sixteen, the Ruashid often quite young, though some of the Beit Imani delay it until sixteen or seventeen, and the Mahra between seventeen and eighteen and possibly later. The Qarra circumcize at the time they are gathered in their winter cattle camps. Among these tribes the boy sits during the operation which is performed in public by a tribesman of repute in the simple Moslem manner.

throwing-sticks of heavy wood. Occasionally small, deep, circular shields of wicker-work covered in skin are seen.

On my return to Salala I found a large party of Bedu assembled. I reduced their numbers to thirty after much argument, since both the Wali and their sheikhs maintained that there was danger ahead of us from large raiding parties, and while confident that an even smaller party would suffice I had not the knowledge to argue further. They were Bedu of El Kethir, mostly from the Beit Kethir, whose head Sheikh Salim Tantim, an amazingly active and very pleasant old man of eighty, was to accompany me. He had been with Bertram Thomas on his journey to Mughshin, as had Sultan, sheikh of the Sh'asha section, another very remarkable personality. These Bedu distinguish all tribes in and around the Rub el Khali as Hanawiya or Ghaferiya, terms which originated in a civil war in 'Oman, apparently about two hundred years ago, when Mohomed Bin Nasir el Ghaferi supported the claims of Imam al Yaraba's infant son against Halaf Bin Seif el Hanawi. But as used to-day by the Bedu, who are ignorant of their origin, these terms appear to correspond with the distinction between tribes of Yemen and Nizar origin.[1] In general the Hanawiya tribes support each other against the Ghaferiya, but there are marked exceptions, and the Se'ar Karab and Nahad usually act together while Beit Kethir and Mahra may unite to repel their raiding parties. The Beit Kethir, who owe allegiance to the Sultan of Muscat, extend from the Wadi Shehen, the most westerly of the Mughshin tributaries, into the sands of Ghanim, north of Mughshin. They are divided into the Sh'asha section to the west, the Beit Ghuas, Beit el Hamar, Beit Gedad, and Mesalama in the wadis to the north of Jebel Qarra, and the Beit Musan round Mughshin. They are, with the exception of the Beit Musan, a steppe-dwelling tribe, with a strong tribal consciousness. The Ruashid and the Beit Imani, who have to-day thrown in their lot with Ibn Saud, centre round the sands of Dakaka, though the Beit Imani tend to live on the edge of the steppes where the wadis Dhahyia, 'Araba, Shuait, and Mitan end in the sands. I had a "rabia" from each of these tribes since we might encounter them on our journey.

We left Salala on November 5, crossing Jebel Qarra by the Kismim pass at the head of the wadi Girziz.[2] Cattle-owning El Kethir live here, between the Beit Qatan and Beit Saad sections of the Qarra, whom they resemble, though Arabic speaking, in mode of life and in general appearance. These mountain tribes are unpleasantly avaricious and our camp was soon infested by them, anxious to sell us butter or goats at fantastic prices and to acquire flour from us for nothing. We felt little wish to linger here, desiring rather the open freedom of the desert, and so moved down to the small dirty pool of Haluf

[1] The Hanawiya tribes, collectively called El Kethir, are Beit Kethir and Ruashid who are Aiyal Hamdan; Menahil Ahl Tamim, Beni Saad, Buagi, Ben Muzabar who are Beni Luni; Karab who are Bal Ubaid; and Awamir, Daham, Menasir, Murra, Harrasis, Afar, Ben Aubthan, Bin Kabkabi, Beni Yis, Abu el Harath, Umm Dairaba, Beit Hawar, Sheraifi, Muharam, Bin Duais, Bin Rezaik, Bin Sandal, Beit Khubizan, Beit Berahim. The Ghaferiya tribes are Qarra, Mahra, Se'ar, Nahad, Junuba, Yaffa, Beni Seif, Abu Tahaith, Drua, Ahl bu Dukhan, Beni Ketib.

[2] The wadis in the Qarra mountains from east to west are: Ghesharab, Derbit, Khithim, Irzat, Thasa, Rithot, Thidot, Arbot, Nihaz, Girziz, Gerdom, Nar, Geth, Isheft, Erzok, Ithof, Nakhlit, Dami, Mogshi, Afol, Gethan.

where we watered our camels and filled our skins. The ground here falls away from these coastal mountains in a gradual slope to the sands. Thus Kismim is 2700 feet, Aiyun 2000, Shisur 1400, and Mughshin 580 feet high. The wadis which form the Mughshin system are deep cut into the limestone plateau, with precipitous cliffs 300–400 feet high and stony beds 150–300 yards across, containing a fair amount of vegetation, chiefly samr (*Acacia*), habla (*Zizyphus*), hissar (*Indigofera oblongifolia*), marakh (*Leptadenia pyrotechnica*), matka (*Merremia somalensis*), and safa palms. The intervening ground is generally flat and rocky, often covered with a layer of flints, and devoid of vegetation, except in small pans of hard sand and gravel where there are a few scattered acacias. In their middle courses, the wadis, still shut in between high precipitous cliffs, are very much broader, the wadi Aidam being over 1000 yards across, and the vegetation is more varied.[1] Near the sands the cliffs disappear and the wadis become sandy expanses 2–3 miles across, their courses marked in the gravel steppes by marakh bushes and some silm and habla. Here there are also broad drainage areas of fine gravel and hard sand known as sih [2] where much vegetation grows after rain, ailgi (*Dipterygium glaucum*), derma (*Fagonia parviflora*), gassis (*Cyperus*), tunub (*Chrozophora*), hailama (*Pennisetum cenchroides*), meluh (*Aristida*), ramram (*Heliotropium*), rimth (*chenopodiaceae*), hailara (*Tephrosia apollinea*). Rain had fallen during the Kharif [3] in the desert to the west, and we determined to benefit from the good grazing to be found there rather than travel by the direct but barren route to Shisur. We watered again at Ma Shedid in the wadi Ghudun, from a narrow natural hole in the limestone rock, where the water flows knee-deep at a depth of 45 feet. It is reached in the dark by a descent of seven shelves of rock with the help of ropes. The Arabs say that this water flows from Aiyun to Shisur, and tell how a woman's wooden comb lost at Aiyun was later found at Shisur. From here we crossed to Mdhul or Mdhai, beyond the wadi Aidam, where a trickle of water seeps out from under a low cliff. The water is said to have been more plentiful in the past, and the dead roots of fifty palms indicate that the valley was once more fertile. Under an overhang in the cliff I found a small, well-finished, neolithic jade axe.[4] There are two Moslem tombs in the valley, 15 feet square and 7 feet high, crowned with domes. The walls were of large rough stones and dried mud, and along the top ran a frieze of stone slabs let into the wall in a zigzag pattern, with plaster-covered finials about 1 foot high at the corners. The doors, surmounted by monolithic lintels, were rectangular. The plaster-covered outer domes were straight-sided with low

[1] samr, marakh, raqa (*Salvadora persica*), habla, silm (*Acacia flava*), tamarisk, matka, hissar, luaila (*Iphiona subulata*), harmal (*Rhazya stricta*).

[2] The whole area of the steppe between the wadis Katibit and Jinab is usually called the Sih (plural Siuh) in contrast to the more barren Jeddat to the east of the wadi Katibit. The plateau to the north of the coastal mountains is called the Nejd and the sands Er Raml. The name Rub el Khali is unknown to the tribes who live in this area.

[3] Approximate dates for the seasons are: Saif, March 20–May 4; Hamim, May 5–June 20; the Saif and Hamim together are the Gaidh; Kharif, June 21–September 20; Shetwi, September 21–December 21; Rabia, December 22–March 20.

[4] Dr. W. Campbell Smith notes: "The axe consists of nephrite, one form of jade; specific gravity 2·98; refractive index about 1·62; extinction 12° from length of fibres. Nephrite does not occur in Arabia. The axe-head must have been brought into the country from one of the regions where nephrite was in use in neolithic times."

Kethir boy of the Beit Gedad section. The hair-cut indicates that he is not yet circumcized

View from Kismim pass, Jebel Qarra, looking south to the sea

View from near Kismim pass, looking north over the heads of the Mughshin tributa

rched tops ending in simple knobs, but the inner domes were very sharply pointed. They rested on octangular platforms formed by placing stone slabs across the corners of the rooms. Beside the tombs is a small graveyard, no longer in use since the Bedu believe that the ancient dead would not tolerate intrusion. They know nothing of these tombs other than that a Sheikh Saad is buried here, which is confirmed by a well-executed inscription on the stele of one of the three graves inside the tombs, but unfortunately his father's name is obliterated. One of the sections of the Beit Esh Sheikh,[1] a religious tribe much venerated in these parts, is however Beit Sheikh Saad. The surrounding hills are covered with stone burial mounds, on one of which were two large upright pieces of rock such as are set up to-day on similar graves by the Danakil to scare away hyaenas. Along the watercourses are many trilith monuments, consisting of groups of from three to twenty-five triliths, each trilith of three stone slabs, 2–2½ feet high, standing on end and leaning against each other and with their bases forming a triangle. They are sometimes capped with a fourth and usually round stone. The triliths were a yard apart and set up in line, each group surrounded by an oval border of small stones. The number in a group varied, five being the most frequent number, and I noticed groups of three, five, seven, nine, twelve, fifteen, and one of twenty-five. They were aligned with a wadi or path but otherwise had no special orientation. Some of the slabs bore Himyaritic [2] inscriptions. On one side of each group, parallel with it and some 9 feet away, was a line of fireplaces consisting of piles of small stones such as are to-day used to grill meat. Sometimes there were large stones arranged singly in line and suggesting seats. Among the monuments were a number of burial mounds and circles 12 feet in diameter, marked out with large stones, filled in with a level layer of small stones. I am satisfied that these triliths do not mark the site of graves, since I have found them erected above solid rock, and it seems clear that these people buried their dead in the tumuli. Even to-day the Bedu on the plateau seldom dig a grave but wall their dead in against a cliff or rock. I believe that these triliths are monuments, probably erected to commemorate men of importance. I have found triliths as far east as Andhur and as far west as the side wadi above Saum in the wadi Hadhramaut. There were none in the steppes of the lower wadi courses.

We continued down the wadi Aidam to Qafa'. In one place where the Aidam was 1060 yards across, there was debris 18 feet up on the steep cliffs which shut it in, deposited there by a terrific flood about sixty years ago. Thirty years later there were three floods on consecutive years, each nearly as devastating as the earlier one. At the junction of the Shehen and Atina we found large palm trunks carried down from Habarut and great quantities of silt deposited throughout the wadi's length. All four floods occurred in the Hamim, between May and June, but since then there has been no rain during these

[1] The Meshaikh in these parts are Beit Sheikh Saad, Beit Ishtet, Beit Zeina, Beit Salim, Beit Derwish, Beit Rekeb, Bilhaf.

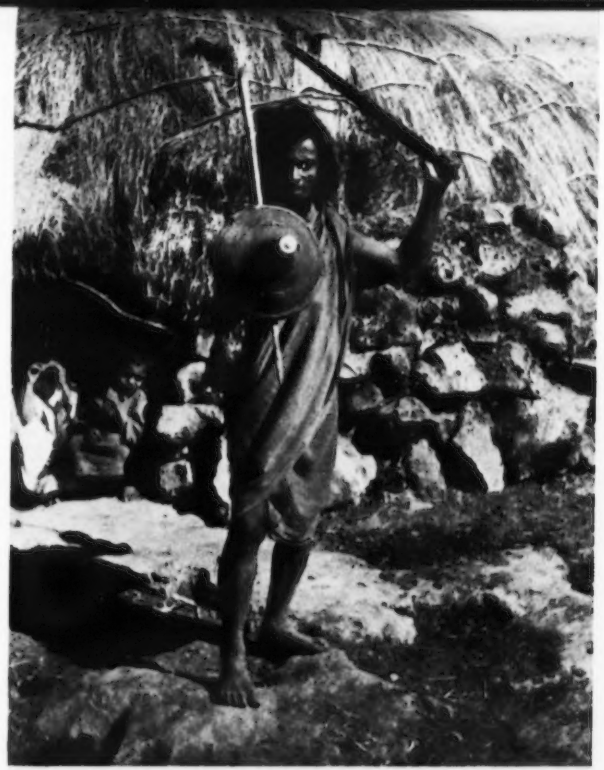
[2] Mr. Beeston notes that the graffiti shown in a photograph are not properly "Himyaritic" in the sense of being strictly south Arabian in character of the script, but are rather of the type called "Tamudic" which is a variety of script found in pre-Islamic inscriptions of north and central Arabia, though it is closely allied to the south Arabian script proper.

months. There appears to be no fixed season for the rains in the area which I visited, and while lack of rain is everywhere the rule rather than the exception, when it does fall it tends to be very local and may occur at any time of the year. The Bedu say that in the past it was most frequent in the Saif and Rabia, but that for the last four or five years it has tended to come in the Kharif or Shetwi. Winter rain generally lasts the longest and produces the best vegetation, while the heaviest storms occur in the summer, but the great heat at that season soon withers the resulting herbage. This year a drought, covering the past five to seven years, was broken by unusually heavy and widespread rain in the last week of July. The area covered by this extended as far north as Sulayil, which had seven days' continuous rain, the Yemen foothills, the Hadhramaut, where floods occurred from July 26 to August 3, and east as far as the wadis Habarut and Aidam.

At Qafa' [1] I left all but two of my men to celebrate the Eid on a rapidly drying pool, and accompanied by these two I travelled westward as far as the wadi Mitan. Eocene fossils were common here, scattered everywhere over the gravel steppe, and later I was to find them in even greater numbers along the wadi Shalhamit. Elsewhere I found only occasionally specimens, and I noticed none on the Jeddat ez Zaulia to the east of Ramlat Sahma. I was especially interested when the Beit Imani who was with me pointed north to Ramlat Shuait and volunteered that the ancient city of Ubar was buried there beneath the sands, a belief which I was later to find generally held by these Bedu. It was the hope of finding oryx (*Oryx leucoryx latipes*) which had induced my companions to forgo the celebration of the Eid. We soon crossed fresh tracks, and on the Mitan we saw ten in two days, but they were very alert and it proved impossible to get near them on these bare open plains. We judged from the tracks that there were many more to the north. They prefer these bare gravel steppes, even where there is but scanty grazing, to the sands. We found few tracks in the rich and undisturbed grazing in the Ramlat Sahma, whereas there were big herds on the barren plains of the wadi Katibit. Although they were much hunted and a middle-aged Beit Imani told me that he had shot eighty-two (eighteen in one year), they are still common in these southern steppes. Ostrich have been extinct in southern Arabia for a long time, certainly for more than twenty years, and the Rim (*Gazella marica*), though fairly common in the "Arfaj" country to the north, are very scarce here, none of my men having seen one in recent years. Other gazelle (*G. saudiya*) however are numerous both on the plateau and on the steppes, especially in the wadi Mughshin, but they are scarce in the sands, although we found a few tracks in Ramlat Sahma. Ibex (*Capra hircus sinaitica*) are to be found from Andhur to the Hadhramaut, wherever the wadi cliffs afford them a home, several fair-sized herds living among the precipices on the northern face of Jebel Qarra. Leopard inhabit the jungle-filled gorges on the southern face of this mountain and are occasionally shot by the Qarra. Near the head of the wadi Jinab I found the tracks of a "Fahad" [2] chasing a gazelle, evidently from its tracks and from the Arabs'

[1] Eagle stones (chalcedony concretions), known as Jiljila, were very abundant on the wadi cliffs a few miles above Qafa'. Some were as large as footballs. Some of the lighter and smaller ones have been carried by floods as far as Mughshin.

[2] The word Fahad was used in some inscriptions *circa* 100 B.C., found by Mr. Philby



Qarri tribesman with shield, sword, and throwing stick

Typical Qarri tribesman

Ghaf acacia in bloom despite twenty-five years' drought, in the sands at Nakhlat el Gharbia, north-west of Mughshin

The Sahma sands, showing dunes and gravel plain (sabkha), with harm salt bushes

description a cheetah. Wolves and hyaenas are common on the plateau, and desert foxes and hedgehogs in the sands. I saw the tracks of a vatel near the Mitan.

After rejoining the others at Qafa', we travelled across a bare featureless plain to the wadi Ghudun and watered at Shisur, where the ruins of a crude stone fort [1] on a rocky eminence marks the position of this famous well. At the bottom of the large cave, undercutting this mound, there is a scanty trickle of dirty water in a deep fissure, which can only be reached with difficulty down a narrow passage between the rock wall and a drifted bank of sand, 30 feet in height, half filling the cave. The only permanent water in these central steppes, it is a necessary watering-place for raiders and has been the scene of many fierce encounters. There was no water between here and Mughshin, 140 miles away, so we filled all our skins, inevitably a lengthy process. During a journey these skins develop numerous small leaks, which are plugged with thorns or suitably sized splinters of wood wrapped round with cloth, precarious in appearance but effective in practice. A nine-hour march across the empty steppe brought us at sunset to the wadi Umm el Hait on the edge of the sands, and it was a stirring moment when the long, rose-coloured wall of the sands first appeared across our front. The Umm el Hait has suffered from more than twenty years of drought and only the ghaf acacias (*Prosopis spicigera*) and marakh bushes still showed signs of life. At Mersaudid, which we reached in seven days from Shisur, travelling by the northern branch of the wadi, known as el Aradh, I turned north into the sands with eight of my companions, while the others went on to Mughshin. But first we grazed our famished camels for half a day among the dunes of Nakhdat el Gharbia on a grove of large ghaf trees, whose long trailing fronds were in flower despite a quarter century of drought. The sands of Khasfa and Ghanim consist of isolated dunes 200–300 feet high, rising like mountains from the gravel floor, whitened in patches with gypsum and green with "harm" (*Zygophyllum*) salt bushes. Ablab (*Ephedra foliata*) and arad (*chenopodiaceae*) grow on the dunes, which are of a great richness and depth of colour, a glowing carpet woven with grains of red and silver sand. Rain had fallen here and for 100–150 miles to the north in the winter of 1944 for one full night, so that the pasturage of zahra (*Tribulus*), ailgi, and gassis was green and plentiful; for the Bedu reckon that one shower of rain penetrating into the sands to elbow depth will produce good grazing, and half an hour's heavy rain will suffice for this. More rain is required on the steppes than in the sands, and yet in the wadi Katibit we later found heliotrope still green and in flower after a shower three years before. The Bedu, Beit Musan and Ruashid, had already grazed this area and moved some six to ten days farther north.

My Arabs now ranged far and wide on foot over the soft dunes, collecting armfuls of tribulus with which to handfeed their hungry camels as they moved along. Three of them lingered behind on tired camels to arrive at Khasfa

[1] 'Uqla, about 15 kilometres west of Shabwa, and in classical Arabic Fahad can only mean a cheetah. There is I believe no authenticated record of cheetah from Arabia, though there are reports of them from the Kuwait district. In view of the geographical distribution of the cheetah, it would be strange if it did not occur in Arabia.

[1] Some shards found here were probably early Islamic.

well [1] two hours behind us. Although suffering from thirst, for our water had been long exhausted, no man drank until the loiterers had arrived, for such is the custom of the Bedu. Likewise if a man is absent no one will feed until he has returned. To live at ease among them it is necessary to do more than wear their clothes. Isolated from the outside world they know no standards but their own, and it is by these standards that the stranger will inevitably be judged. To win their respect he must match their endurance, walking as far and riding as long, and bear heat and cold, hunger and thirst with their uncomplaining indifference. It is better to live among them as one of them, helping in the everyday tasks and sharing in common the food and water, rather than apart in a tent or tended by a servant. To these Bedu it would be unthinkable that a man should travel with them and yet refuse to share his food among them, for they would share theirs, however short, with all comers.

In the sands of Khasfa and Ghanim the water, which is brackish but just drinkable, varies in depth from 3 to 9 feet and is abundant, the wells being in the gravel floor, generally under the north or north-east side of a high dune. At Khasfa my men identified some month-old tracks as those of a raiding party of sixteen Awamir from the north. Later we heard that these raiders had lifted fifteen camels near El Jazir off the Junuba, three of whom they had killed, in a raid which had taken them right across the Rub el Khali from the Persian Gulf to the Indian Ocean. The discovery of these tracks disturbed my men, for we were a small party, and that evening the howling of a wolf, rare in the sands, was mistaken by them for the cry of raiders and kept them on the alert throughout the night. The Bedu read tracks, even on sand after a month, with uncanny skill, for their very existence often depends on their ability to interpret them correctly. Every man knows the individual tracks of his own camels, and will probably remember those of most of the camels which he has seen. They can tell at a glance whether a camel was ridden or free and if it was in calf. By studying strange tracks they can tell the area from which the camels came, and probably the tribe to which they belong, and from the droppings they deduce where they have passed and when they were watered. They claim that a real expert can identify a calf which he has never seen from the resemblance of its tracks to those of its mother. Several times we crossed the path of raiders, which one of the party would follow on his camel for a short distance to return with details of who they were and whence they came.

At Mughshin we found our main party camped among the ghaf trees near a fair-sized grove of untended palms, whose dates are collected in September and divided among the Kethir tribes. There is a shallow ditch of very brackish water [2] 300 yards long among these palms, and a small spring of fresher water rising on its bank, which the Awamir had fouled on their return to delay pursuit, after filling in the nearby well of Meteki. A small Drua raiding party had also passed through here a few days before. They had taken fourteen days

[1] Khasfa is the name given to any well reputed to have been made by a falling star. Nothing in the appearance of this well supported this theory.

[2] Analysis of the salt shows an impure common salt, containing a fair proportion of calcium and magnesium sulphates.

from Ibri and had watered their camels at El Abeila in the wadi Ameiri. They had reported rich and untouched grazing in the Sahma sands, and oryx herds. I left Mughshin on October 13 accompanied by another party of eight. We followed the wadi until after 25 miles it ended against the sands [1] and the imperceptible rise of the Jeddat el Harasis in a broad, silt-covered pan sprinkled with ghaf trees and desiccated "terfa" tamarisk. We crossed the Ramlat Sahma in five days to the Jeddat ez Zaulia, a lifeless gravel plain, whitened in patches with gypsum, lying beyond the eastern limits of the sands. We followed the edge of this steppe north for half a day before returning to Mughshin. I had hoped to reach the quicksands of Umm es Samim, a sump formed by the wadi Ameiri and reported by the Bedu to cover an area of 400 square miles. It lay 40 miles to the north of us when we turned back, beyond the Ramlat Gharbaniat. We were however short of water, and there is none in any of these sands, the nearest fresh wells being in the wadi Ameiri beyond the Jeddat ez Zaulia. Forty miles to the north-west of us was the Ramlat Ghafa and the well of Khor en Naga, its water fit only for camels. Beyond that, in Ramlat bin Saidan, there is abundant but very brackish water. The Arabs report a well, Gasaiwara, in the sands of Rabadh north-east of Ramlat bin Saidan, and another well, Umm ez Zammal, between Gasaiwara and the wadi el Ain, but they say that other than these there is no drinkable water in any of these eastern sands. Raqi well, in the Jeddat el Harasis, was distant about 70 miles to the south-east, and between there and El Jazir there is a well at Boi. Khasfa well had been filled in by raiders and there is no other water in this steppe. In Sahma, dunes 200 feet high, resembling in shape those of Ghanim, rise abruptly from the surrounding sands, cream and white or gold and green in colour; but here the gravel and gypsum floor, through which the limestone rock often intrudes, is exposed in long parallel valleys, from 1 to 2 miles across, running north-east and south-west. The Bedu call these gravel flats "sabkha," although in Sahma I saw only one real salt pan and few in Ghanim, all of them marked by clumps of "terfa" tamarisk. On the south-east side of the valleys the sands are soft and the slope nearly vertical, while on the north-west side the incline is gradual and the sands firm. It is on the north-west side that the vegetation grows, bushes of ablah arad and hadh (*Traganum nudatum*), and after rain ramram, barket, ailgi, gassis, saadan (*Neurada procumbens*), faira (*Danthonia*), gurn (*Monsonia nivea*), lefaifer (*Indigofera viscosa*), meluh, and a little zahra. Heavy rain had fallen here and the dew was often drenching. Once we woke to find the sands covered by a thick ground mist through which the dune tops showed like islands. Everywhere was rich grazing, which the Bedu scouts had failed to find, where butterflies [2] flitted from plant to plant and many desert larks enlivened the sands with their pleasant song. Other birds were rarely seen except for ravens round the wells and occasional kestrels, shrikes, and wagtails. Once a large owl circled round our camp

[1] The reading of the aneroid was here 550 feet. For Mughshin I got an average of 580 feet, but there was a variation of 165 feet between the two extremes. Mersaudid 725 feet; Ghanim sands 650–425 feet (taken at the wells); Sahma sands 720–680 feet; the edge of Jeddat ez Zaulia 750 feet.

[2] Among the butterflies collected were specimens of *Danaus chrysippus*, *Colotis evagore*, *Anapheis mesentina*, *Acraea neobule arabica*; and the following moths: *Utetheisa lotrix*, *Dyspessa* sp., *Anumeta* sp.

throughout the night. Jirds (*Meriones* sp.), jerboas (*Jaculus* sp.), and gerbils (*Gerbillus* sp.) were common where rain had fallen, scampering round us as we slept. We passed a few fresh oryx tracks heading north and my men were convinced that there were big herds collected near the Gharbaniat sands. They craved hungrily for meat, for our unvarying diet was of unleavened bread, baked in the ashes of the fire, or of porridge if the water sufficed. We fed but once a day at sunset, occasionally allowing ourselves the luxury of a few dates at midday. Several of the riding camels were in milk and provided us with a welcome drink, but poor grazing and long marching hours considerably reduced their yield. We drank black bitter coffee and tea flavoured with ginger, but the water of the sands made even these unpalatable, and for two months I drank no water, so filthy was its taste, except in this tea or coffee. Since the weather was cool, sometimes really cold even at midday, I suffered no inconvenience.

From Mughshin we travelled in seven days to Andhur, following the wadi Katibit through the barren Jeddat el Harasis. Oryx were numerous here, despite the scanty grazing, and in one day my men estimated that we had crossed the fresh tracks of more than forty. They shot two and rode down a young calf about a fortnight old. It throve on camels' milk, though at first it complained unceasingly in plaintive bleating grunts. Andhur belongs nominally to the Bautahara, to-day a tribe of little standing who live along the coast supporting themselves largely by fishing, but is in fact used exclusively by the Thuar section of the Mahra. It is 1820 feet high and there is abundant fresh water on the surface beside a large, untended, almost impenetrable, grove of date palms growing in the wadi bed, shut in by precipitous cliffs in very broken country. On a cliff-bound island above this grove is an interesting ruin. A low oblong outer wall, 80 feet in length and 2 feet high, built along the edge of the precipice, surrounds a rubble mound 30 feet long lying in the northern half of this enclosure. Set into this mound is a room 12 feet by 7 feet and 5 feet high, whose floor is level with the ground outside and whose walls are of roughly faced stones set in mortar. A narrow stair leads down into it. At the southern end of the mound is a wall, rising 9 feet from the rock floor and 4 feet above the top of the mound, of roughly faced stones, mortared and laid in regular courses, with quoins of well-dressed ashlar. A number of troughs, 5 feet by 2 feet by 2 feet, each cut from a single sandstone block and lined with cement, are set in the southern half of the outer wall. I later found a number of similar troughs set in some ancient walls near Salala. This was the only ruin built with mortar that I saw throughout my journey.

We now crossed the tributaries of the wadi Katibit, passing through groves of frankincense, to the pool of Hanun on the northern slopes of Jebel Qarra. There were some Beit Gedad here, the first Arabs other than my party that I had seen since we left Qafa' forty-four days before, during which time we had travelled about 700 miles. We descended to the sea by the wadi Arbot. This wadi and the wadi Girziz are the only two practical routes from Dhofar across the mountains, and are used by travellers going to 'Oman. We arrived at Salala on January 9.

A Rashdi sheikh was waiting for me with a number of his tribesmen. I had met him at Qafa', and arranged with him to meet me here with men and

camels to accompany me to Tarim across the western steppes.[1] I engaged twelve of these Ruashid and Beit Imani, and also two Mahra and a Menhali to act as our "rabia" when we were among their tribes. I retained three of my Beit Kethir, Sultan, his son, and Musellim bin Tafal, sheikh of the Mesalama and a hunter of renown. Ten other Ruashid accompanied us, sharing the pay of their fellow tribesmen and trusting to get a reward. I had liked and admired the Beit Kethir, but I had often been irritated by their avarice and I found these Ruashid much less grasping. The Ruashid[2] dwell in the central southern sands, their Beit Imani section living in the borderland of steppe and sand between Ramlat Fasad and Ramlat Dhahyia.[3] While in the sands they live in tents, of the usual black Bedu type, but never carry them into the steppes. The Beit Kethir and Mahra never use them. These Bedu are not numerous and possess few camels, for in the Rub el Khali water and grazing are very scarce. Most of them own eight to ten camels and few of them as many as twenty. Small and slightly built, these Arabs are very hardy, for here none but the fittest can survive. All these southern tribes wear the loin cloth, for drawers are worn only by women, and some of them wear a smock over the loin cloth. Their hair is black, straight, and generally of moderate length, but sometimes it is long and braided. Many of them are bare headed, with a leather thong wound round their locks, while a few twist a cloth round their heads. Some but not all of their women are veiled. Sandals are unknown, but sometimes in the sands during the heat of summer they cover their feet with rough socks. Their weapons are rifles and daggers. They are deeply religious and strict in the observation of their prayers[4] and fasts, several of my men compensating during these journeys for a failure to keep the fast in the previous Ramadan. Their world is Arab and Moslem, and outside this the distinction to them is one of Moslem and non-Moslem. Few if any of them have heard of the English as such, for to them all Europeans are but Christians and nationality has no meaning. They had heard of the war only as a war between Christians, and of the Government of Aden only as a Christian Government, yet they are not fanatical. Cheerful and easily amused, they are generally good tempered, though quick to resent a slight and passionate when roused. They never seek to impose upon each other nor to shirk in the common toil, but rather offer themselves with noisy insistence for every task, while their sheikhs are always among the first to gather wood or to dig out a well. I found them courteous and thoughtful in all their dealings. Loyal to each other, their blackest crime being to desert a companion on the road, they are yet callous of suffering and without regard for human life, and to avenge a death will cut the

[1] There are four routes from Dhofar to the Hadhramaut: (1) my route by Sanau and Thamut; (2) Habarut, Shalhamit, Sarif (wadi Kadiut), Kadiut village, Minar village (wadi Mohorat), Ej Jelt, Maksi (wadi Washa), Ed Dahil; (3) coast route: Rakhyiut, Jadib, Damqut, El Fatk, Yarub, El Ghaidha (Ghaila), Mahaifif, Harut, Dhobut; (4) coast route to El Ghaidha, then a ten days' direct route to the Hadhramaut by Dahāl, Shaltan, Yahul through Mahra country.

[2] Sections of the Ruashid are Mdairaba, Msaifar (includes the Sa'adna sheikhly family), and Beit Imani, to-day virtually independent.

[3] These tribes pronounce DH as L and in consequence call Dhahyia Lahyia, Mdhul Mlul, and Mdhai Mlai. They also substitute Y for J.

[4] Qarra, Mahra, Beit Kethir pray singly, the Ruashid and Beit Imani together in line.

throat of an unarmed herdsboy with a jest. Generous with their food and water, sharing it among all comers with improvidence, they are yet grasping and avaricious, talking unceasingly of money and arguing heatedly for days about a dollar. But petty theft is practically unknown and money can be left about with security. They will beg unashamedly, and flatter with a childish lack of subtlety in the hopes of obtaining their desire. Gregarious, they know no privacy, and their conversation is always communal and noisy. As long as an Arab is within earshot of others he will express his views and as soon as he is out of hearing he will burst into song. They delight in poetry, using it naturally in their everyday descriptions, and will listen appreciatively for hours when a bard recites.

Camels [1] alone make life possible in this empty wilderness, and their welfare is at all times the Bedu's main preoccupation. Indifferent to their own wants, provided those of their camels are satisfied, they will dally endlessly on the march while among good pasturage, or push on without a stop and regardless of fatigue through barren country to attain it. When at last we reached the wadi Hadhramaut and a lavish hospitality such as these hungry Bedu had never dreamed of, they fretted immediately to return to the empty sands where their camels would find the grazing to which they were accustomed. They sing to them and encourage them while on the march and I have never seen them strike or ill-treat a camel. They ride, sitting behind the hump on the light 'Omani saddle,[2] generally in a kneeling position, and seldom travel faster than a walk, never doing so if covering a long distance. Many of them possess good camels of the famous 'Omani breed, such camels being renowned far and wide among the tribes. They have very few bull camels with their herds, for these are generally slaughtered and eaten at birth, and they are often reduced to taking their "nagas" long distances to get them served. On good pasturage their herds remain for months without water, their owners living on milk. When travelling they are watered if possible in the cold weather every four or five days, but can travel for ten to twelve days between wells without difficulty. Water is very scarce, particularly in the steppes, yet it is rather the lack of grazing which presents the Bedu with their main problem. It is very rare to hear of Arabs dying of thirst, and those that do perish in this way are usually in pursuit of raiders, whom they have followed into sands unknown to them where the tracks have been wiped out by wind. When desperate with thirst they can fetch liquid up from a camel's stomach by thrusting a stick down its throat, and many of them drink with relish this "fadh" from the stomach of a slaughtered camel. On journeys they carry skins full of sour milk, diluting it with brackish water as it gets scanty. Many families live largely, and a few entirely, on the milk from their small flocks of goats, but their existence is always precarious and many of them died of starvation during the past years of drought, for the milk supply dwindled to nothing and they

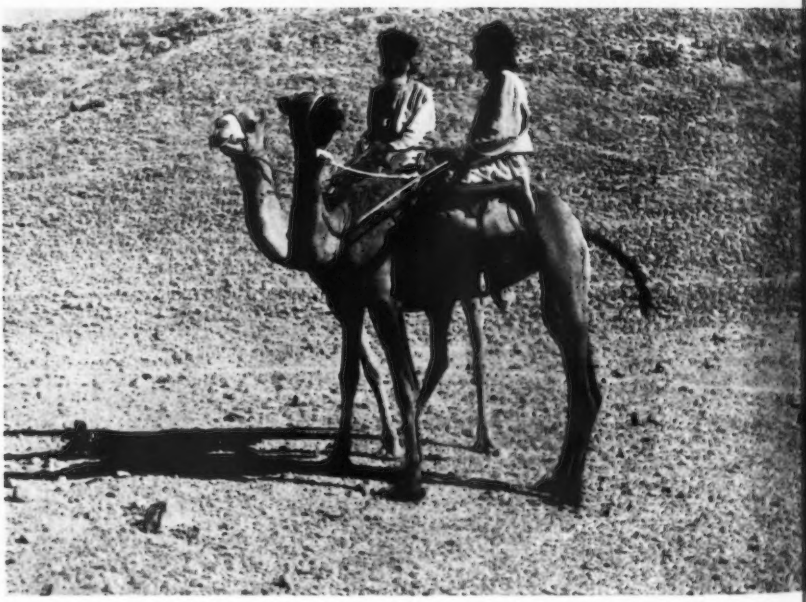
[1] Camel names used by these tribes are first year Mahaulia, second Bint Labun or Jidha'a, third Mazruba, fourth Theni, fifth Rubua', sixth Sidas, full grown Muni. They use the word Bosh for their camel herds. I had previously only heard this word in Jebel Druze.

[2] The Beit Kethir, Ruashid, Beit Imani, Mahra, and Menahil use this saddle. They refer to it as Shedad and do not know the name Zana. The Murra, Se'ar, and western tribes use the two-poled riding saddle.

Leaders of a Menahil raiding party at Helaya, drinking coffee

Sultan, Sheikh of the Sh'asha section of the Beit Kethir, who accompanied the author

Typical vegetation in the Siuh near wadi Ramah, seven months after rain



Beit Kethir Bedu who accompanied the author. They ride kneeling behind the hump

were then reduced to supplementing it by slaughtering their flocks. Bedu who are without a camel are unable to carry water and, tied to a well, are unable to graze their flocks at a distance when the surrounding pasturage is eaten up, while those families who own a camel can sell a goat at Ghaidhat el Mahra and bring back a load of sardines, which is sufficient to keep a family of four alive for two months. The Menahil, but not the Beit Kethir nor the Ruashid, own sheep of a small white breed. None of these tribes keep dogs or donkeys, and there are of course no horses in the Empty Quarter. The scanty grazing compels these tribes to live scattered in small family groups over wide areas, while fear of raiders keeps them constantly on the alert, ready to drive off their herds at the first suspicion of danger, for thus scattered they can offer no resistance. Once raided, their only hope of recovering their stock is to collect a sufficient party and set forth in pursuit. The raiders, knowing that as soon as they have been sighted a party will collect to oppose or pursue them, lift what camels they can find and escape with all possible speed, delaying pursuit by filling in any wells they use. Goats they will slaughter for food, and if there is blood between their tribes they will ruthlessly kill any man they can lay hands on. Women and children they never molest. Fierce fights occur when they are overtaken or surprised by another raiding party, and casualties are heavy, for many of them are deadly shots and quarter is rarely given.

I left Salala again on January 14, crossing Jebel Qarra once more by the Kismim pass. At the very head of the wadi Ghudun lies the pool of Aiyun, shut in by sheer-sided, limestone cliffs 200 feet in height. Fed by a small spring, it is 150 yards long, 30 yards across, and of great depth. Its still green waters are fringed with rushes, while below the pool the wadi bed is choked with a jungle of tamarisk and "hissar." The Arabs believe that a monster serpent lives in Aiyun, feeding on their flocks. Snakes, which abound in the jungles and on the downs of Jebel Qarra, are uncommon in the desert, but once one of our camels was bitten by a viper. It recovered although it was very sick for several days. At Mesanain, in the wadi Difin near its junction with the Habarut, I was shown a tunnel 20 feet up in a cliff face, inaccessible except by a rope from above. The tunnel, whose mouth was 2 feet by 4 feet, had been filled throughout with a plug of clay which the Arabs, who have a tradition of treasure buried here, had recently tried to remove. They had dug out the upper half of the plug and claimed to have penetrated some 40 feet down a twisting tunnel. There was a considerable pile of excavated earth at the foot of the cliff. They had however given up without reaching the end of the plug. Habarut belongs to the Beit Kethir but is largely used by the Mahra. This tribe is apprehensive of a forward policy on the part of the Aden Government, and there was some wild talk among the young warriors of fighting rather than allowing the Christian to water here. My men took it sufficiently seriously to seize the well and surrounding hills at dawn. These Mahra belong to the Bin Zabnot [1] section. They are a powerful and numerous tribe, living

[1] The Mahra are divided into the following sections: Bin Ali Muqadam, Bin Zabnot, Harawiz, Beit Samada (Beit Amergid, Beit Fanzukh, Ben Azab), Beit Kulshat, Beit Moghthiq, Beit Qumsait, Beit Gidah, Beit Yishal, Beit Thuar, Ben Ziad, Ben Rafit, Beit Kuda, Bin Muhumid, Salawam, Beit Samadr, Beit Tsaifut, Beit Satain, Beit Musmor, Beit Arshai, Beit Aqid, Beit Mahamad, Beit Yasir, Ben Nagi, Bin Hidara, Beni Sahail.

in the coastal range between Jebel Qamar and the mouth of the wadi Hadhramaut, but there are sections of them as far east as Andhur. They speak a language of their own, understood by many of the Beit Kethir, which is probably of the same root as the Qarra dialect. They resemble the Qarra in appearance and are accounted Ghafaria. Between them and the Beit Kethir there is little friendship. Many of them were watering their camels at the shallow scoups in the wadi, for here the water is abundant and almost on the surface. The women had green and blue stripes down their noses, chins, and cheeks, and one had her face painted completely green, which was singularly unattractive. Among them were a few Afar, who to-day are no longer accounted tribesmen, and the greater part of whom live to the east near the 'Oman mountains. They speak the Mahra dialect. The wells are 2000 feet above sea-level, and they are close to a fair-sized palm grove owned by the Beit Kethir but rented by the Mahra. Above the wells there is a ruined fort, and on the far side of the valley some round buildings of rough stones, without any apparent entrance, half buried under an earthen mound. The Bedu suffer from malaria, eye diseases, and an acute colic which completely incapacitates them for several hours. Stomach trouble is their most frequent complaint and few of them but show the scars of branding which they use as a cure for all their ills. I also saw a leper here, the only one I encountered in this country. From here we went to Shalhamit, where we dug many shallow wells and took three days to water our thirty camels and to fill our skins. Shalhamit too belongs to the Beit Kethir, but is used mainly by the Mahra. Our next watering-place was the wadi Khawat, a tributary of the Mitan, in Beit Imani territory. Water was equally scarce here and it took us a further three days to water our camels. There was good grazing nearby and we were soon feeding fifty guests from the Mahra, Ruashid, Beit Imani, and Bilhaf. Salim bin Gawaret, sheikh of the Bilhaf, was there, an old man with an unquenchable thirst for coffee. These Bilhaf are a religious tribe, one of the Meshaikh, and keepers of the tomb of Sheikh ej Jauhari on the coast. Until recently they did not carry arms. Here I enlisted a seventeen-year-old Beit Imani boy, Salim bin Kabina, whose half-brother Mohomed, son of Saleh bin Kalut, Bertram Thomas' guide, was with me. Both were generally known as Bin Kabina, for among these Bedu, but not among the Qarra nor I think among the Mahra, a man is commonly named the son of his mother.

To the west of Khawat, as far as the wadi Jinab, we travelled across gravel plains and "siuh," green from the heavy rain in July, where scattered families of Bedu were grazing flocks of goats and occasional camels. From these we heard of a large raiding party of Daham, which was raiding the Menahil. My men were now continuously on the alert, pushing scouts out far ahead when we moved, and posting them on the hills around when we halted. At Sanau, 25 miles from the sands, there is a stone-lined well, 40 feet deep, in a bare valley among broken gypsum hills. Here we found fresh tracks of a small Mahra raiding party but none of the Daham. This well, close to which is a ruined, two-towered fort and a graveyard, is much used by raiders. I noticed a sulphurous smell at the well mouth, and there are said to be poisonous gases in it which have caused several deaths. We watered nearby at a shallow scoop in a steep-sided watercourse called Mdhul, 1800 feet above sea-level, and

again in Menahil[1] territory at Muger wells, among low barren gypsum hills, where there is a scanty supply of really bad water. There was another ruined fort here, and lying close by was the skull of a Menhali killed by Se'ar the year before. I smuggled it away with me and it is now in the Royal College of Surgeons Museum.[2] From here we followed the tracks of the Daham raiders, who were forty-five strong. They had lifted fifty camels nearby, and had shot down two unarmed Menahil herdsmen. Until recently the Se'ar were the terror of these western steppes, raiding as far east as Shisur and Andhur, but in the past few years the Daham, who come from Yemen territory, have gained the ascendancy. The Menahil fighting men had largely gone off in pursuit, and our appearance spread panic, more especially as my men were all wearing smocks and several of them had the very long pointed sleeves which the Daham affect. Shots were frequently fired over our heads, whereupon our Menhali "rabia" rode forward alone waving his head-cloth to establish contact. An accepted signal of friendly intentions is to throw up sand into the air which, drifted by the breeze, is visible from afar, and we used this constantly. One family among whom we halted had suffered the grievous loss of eight goats slaughtered by the Daham for food. They had been disgusted when some of them milked the goats straight into their mouths.

At Thamut,[3] 2160 feet above sea-level, there was another stone-lined well 50 feet deep which, after it had been cleaned out, provided an abundant supply of good water, the first sweet water we had drunk since leaving Khawat. This well, Helaya nearby, Muger, and Sanau, are the wells which raiding parties must use, for there is no water in the sands to the west of Zuwaira and Turaiwa in Dakaka, other than a dubious supply in the Ramlat el Khirkhad between the ends of the wadis Dhahyia and Aiwat el Menahil. Near the well is a cemetery and the grave of Sheikh Laghaibar, where offerings of coffee beans are left inside a small dome, containing cups, a coffee pot, pestle and mortar, from which store wayfarers may brew themselves coffee. This pleasant custom is found also at the grave of Rai el Makhari at the head of the wadi Washa. Helaya well is 25 feet deep with a limited supply of sweet water. Here we camped beside the ruins of another two-storied fort. At dusk the scouts reported a large body of Arabs behind a hill and, before we could give orders for the camels to be driven in, the camel guard opened fire upon twenty mounted Arabs who suddenly charged down upon them, whereupon they immediately swung under cover of a low ridge and fired back, but soon evinced some uncertainty. We contacted them and found that they were Menahil returning from pursuit of the Daham. They had mistaken us for another Daham raiding party, but had recognized us as being from the east when they heard our shouts. We now marched through broken country, parallel

[1] Sections of the Menahil are: Beit Kizim, which includes Beit Nahat and Beit Awailan; and Beit el Masheni, which includes Beit Ibagia, Beit Sabula, Beit Himaid, and es Samah.

[2] Professor A. J. E. Cave describes the skull in a note held at the Society's House. He concludes, "On morphological and osteometric grounds, the cranium is clearly that of a member of the Mediterranean race, whose distribution in past and present times includes the Arabian peninsula."

[3] The Menahil and Awamir share Thamut well. The Awamir are on the Jinab Hardha and upper Khudhra.

with the high, table-topped mountain of Habshia, until we crossed at 3500 feet the watershed between the tributaries of the Hadhramaut and the head of the Jinab. We then descended the wadi Washa and, finding no water at Makhari, we watered at Hessi Nimrit, and shortly afterwards, crossing into the Arada, we descended to Saum. These boulder-strewn tributaries of the Hadhramaut are enclosed between precipitous cliffs, 400 feet high, where ibex are plentiful. From Saum we travelled slowly up the main wadi to Tarim, overwhelmed by the hospitality of the kindly Saids, arriving there on February 24.

I had hoped to continue my journey across the western sands from Husn el Abr to Sulayil, but was unfortunately prevented from doing so. Three of my Ruashid had intended to come with me, and we had collected all available information about the sands and the steppes and watering-places to the north-west of Tarim. I have included it on my map, for the existing maps, to the east of Philby's route, are extremely inaccurate, some of the wadis being shown 100 miles too far to the east. There are two wells to the north of Husn el Abr; Wid'ia, 50 miles due north from there but reported as dry this year, and the better well of Zamakh in the wadi Hudhi. Both are in Se'ar territory. Minwakh, in the Aiwat es Saar to the south-east of Zamakh, is a big watering-place. The sands commence 20 miles north of Zamakh and are reported as being in the form of high, very soft dunes, in many places impossible to cross except dismounted. On the far side of the sands there is water at Hama, some 50 miles south of Sulayil, but the Arabs are emphatic that there is no water in the sands to the west of Dakaka. Se'ar have crossed them here to raid the Dawasir, but it entails a hard journey of about sixteen days without water. None of the Bedu with whom I spoke had heard of quicksands in this area, and none of them knew the name Bahr es Safi, but while in Mukalla I heard of a Kerbi who, twenty years before, had seen the remainder of his party engulfed while returning from a raid when seven days' journey to the north of Husn el Abr in the sands of Ramlat el Gharagh.

At Tarim I parted with my Bedu, with Sultan whom I liked so much, with Musellim Beni Kamam and his inseparable companion Said bin Musellim, with Mohomed, Saleh bin Kalut's son, and his half-brother, laughing young bin Kabina, with the Beit Imani sheikhs, Awad bin Khazai, one-eyed Abdullah bin Missad, Nimr bin Salim our bard, and the Mahri rabia Maktub bin Hareizi. Proud wild figures, lean and tanned, they were out of place among these soft townsmen, and were anxious to be gone. Lonely and apart, I watched them drive in their camels and depart, back to the clean emptiness of the desert.

Note on the map by Mr. B. SANDFORD, *who plotted the traverses*

The compass traverse from Salala to Mughshin, plotted throughout at an average speed of 2 miles per hour, corresponds so nearly with Bertram Thomas' accepted positions along the wadi Umm el Hait and in wadi Mughshin that the small difference in latitude obtained by establishing El 'Ain (the accepted position being based merely on a latitude) did not merit its adjustment. The march south from Metiki, calculated at a slightly higher rate of advance due to the nature of the terrain, gave the position of Andhur 4 miles north of Thomas' position. The traverse was adjusted at this point, and from here back to Salala, along the edge of the plateau, the rate of advance of 3 miles per hour placed the

track on Salala almost without adjustment. Kismim was fixed from bearings of established points, and the new position thus fixed for Aiyun was confirmed on the Hadhramaut journey.

The traverse from Salala to Saum in the wadi Hadhramaut was plotted at $2^1/_2$ miles per hour and adjusted to Ingrams' position for Saum. Latitudinally the two positions were identical with a small error in longitude. The position for Mdhul corresponded almost exactly on both journeys and was adjusted to the mean.

The information on the map to the west of Saum was collated from evidence supplied by Arabs and ties in quite accurately with Philby's position for Husn el Abr. These positions were all bearings and distances from Tarim, the position of which, already charted, was accepted. The most notable points are the large displacement of the wadi formation to the west, and the positions for Sanau, Thamut, and Minwakh.

[Reports by members of the staff of the British Museum (Natural History) on the various collections made by the author in southern Arabia are being held at the Society's House and may be consulted there. They comprise general descriptions and lists of specimens against the names of the localities in which they were found, by Mr. A. H. G. Alston on the botanical collection, by Dr. L. R. Cox on the fossils, and by Dr. W. Campbell Smith on the rocks and minerals; a report on the insect collection will be contributed later by Dr. B. P. Uvarov. A description of the Menhali skull with osteometrical data and indexes by Professor A. J. E. Cave of the Royal College of Surgeons, and a day-by-day weather record kept by the author throughout his journey are also available.—*Ed. G.J.*]

SOME GEOGRAPHICAL FACTORS IN THE PALESTINE PROBLEM

E. C. WILLATTS

Afternoon Meeting of the Society, 9 December 1946

THE SMALL country of Palestine, not much larger than Wales, holds a place in, and has exercised an influence on, world history and affairs out of all proportion to its size and has done so for perhaps a longer period than any other country. Its natural endowments are meagre, but as a home of spiritual inspiration it is unique. Its geographical position has made it inevitable that it should continue to be a land of inspiration and of problems, a land in which the ceaseless clash of ideologies complicates its culture and its economy. It is situated at the junction of three continents, at the cross-roads of East and West, where the great trade routes of the ancient world intersected. But neither the passing of the old empires whose armies, seeking to dominate those routes, fought more battles in Palestine's confined plains than those of modern powers have waged in the cockpit of Europe, nor the shifting emphasis of modern transport have diminished the significance of Palestine's position, now athwart important world air routes.

The virtual absence of harbours on Palestine's almost unbroken coast was, until recently, a factor militating against the influx of ideas from the west. Palestine embraces the southern tip of the Fertile Crescent and its cultural ties were with Syria and other lands in the Crescent, and with the desert to the south-east whence came Israel's early and powerful patriarchal ideology. The nomadic influence has never ceased, nor has the struggle between the Desert and the Sown.

To-day, Palestine is as much a land of dispute and conflict, of clash of political, religious, and economic interests, as it has been for thousands of years, and the trend of world events and developments does nothing to lessen this. Thus, the Middle East is one of the four major oil provinces of the world and the one most divided between the great powers; the position of Palestine, perhaps itself containing oil, on the fringe of the oil fields and athwart the pipe lines gives it great significance both strategically and economically, making it a focus of political and commercial interest. Recent events, including the work and report of the Anglo-American Committee of Enquiry, have caused public attention again to be focused on Palestine, and it is pertinent to consider some of the geographical factors in the problem of modern Palestine.

The country is one of variety and diversity. Physically, it consists of an upfolded central mass of limestone mountains, dropping precipitously to the east where the northern end of the great Rift Valley contains the Jordan river and the Dead Sea and continues southward towards the Gulf of Aqaba as the Wadi Araba, and flanked to the west by a coastal plain of Tertiary and Recent deposition (Fig. 1). The central hill mass is divided from the Hills of Galilee in the north by the plains of Esdraelon and Beisan, sunken blocks with sharp

faulted sides, covered with deep alluvial soils. They provide an easy route from the Jordan Valley to the Mediterranean, where the coastal plain around Acre is separated from the main maritime plain by the mass of Mount Carmel, whose projecting cape provides at Haifa the only break in the coast sufficient to allow the creation of a significant harbour. In the south of Palestine the maritime plain merges into a tract of loess-covered plain which in turn merges into the desert of the south. To both these last the name Negeb is indefinitely applied: sometimes it refers only to the loess-covered steppe lands, perhaps Palestine's most fascinating problem area, and sometimes to the whole of the desert and semi-desert of the south.

However geographers may divide and sub-divide Palestine,[1] one fact is inescapable. The physical divisions make for disunity rather than unity. There is no natural nodal point to assist unification. The hills and the plains are in sharp contrast; the deep cleft Jordan Valley is no unifying factor either with the lands beyond or, because of the lack of opportunity for settlement except in certain parts, longitudinally. The separation of Galilee from Samaria and

Generalised Block Diagram across Central Palestine

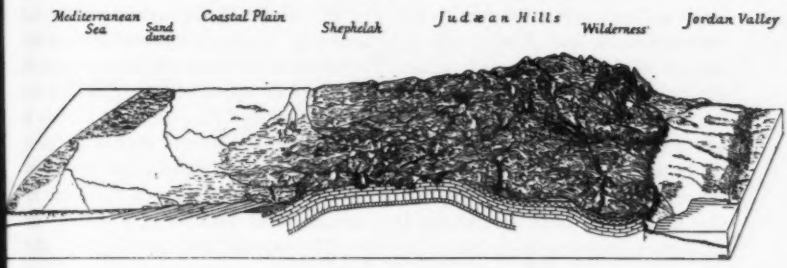


Figure 1

Judah is very striking. Down its long history Palestine has rarely been united politically. City states and local deities flourished, but unity was never achieved except by hated and conquering empires and then not for long. But the isolation and detachment of the hills of Judah encouraged the development, from a unique spiritual heritage, of a national and religious spirit strong enough to survive centuries of exile and loss of independence.

Nature has been unkind to Palestine in that it has left her poorly endowed with natural resources. The country is severely handicapped because it lacks almost any raw materials, other than agricultural, on which trade and industry might be based. The salts of the Dead Sea constitute a noteworthy exception, and the peculiar combination of excessively saline water and intense dry heat enables the Palestine Potash Company to produce from an unfailing source increasing quantities of potash, bromine, and other chemicals for export and for use in home industries. Otherwise limestone, now as in the past

[1] A. Reifenberg, 'The soils of Palestine,' London, 1938, gives six divisions; D. H. Kallner and E. Rosenau, "The geographical regions of Palestine," *Geogr. Rev.* 29 (1939) 61–80, give more than forty.

extensively used for building purposes, is Palestine's only significant mineral resource. She has however, in recent years, enjoyed the immense advantage of an increasing supply of oil brought by pipe line from Iraq. This provides not merely exports of crude oil, petroleum, and other products from the Haifa refineries, but the fuel for electricity generators and other plants and factories within Palestine.

The climate of the country is a factor closely connected with many of its problems. Its general "Mediterranean" characteristics are well known, but it cannot be too strongly stressed that the climate is transitional between the Mediterranean and desert types. While temperatures limit the growth of certain crops, rainfall and water supply are the vital factors. A new map of Mean Annual Rainfall was prepared at my request by the Palestine Meteorological Service and has now been published (Fig. 2).[1] It certainly suggests that there is a little more rain in the higher parts of the desert and a little less in some other mountainous areas than was believed to be the case before the most recent data were available.[2] But the fact must be noted that only 43 per cent. of Palestine receives more than 12 inches of rain and 25 per cent. receives less than 4 inches. Averages are deceptive, and when those for Palestine are analysed they reveal the serious fact that the rainfall is not merely uneven but also unreliable and often of unhelpful intensity. In the desert and semi-desert areas the rainfall is especially fickle. The crops in the loess area are notoriously liable to failure for this reason. The intensity of much of the rainfall is too often over-generous, doing great damage to soil and property not merely in the areas of ample rainfall, where it is common for several inches to fall in 24 hours (Haifa has recorded nearly 11 inches), but also in the dry areas, where in winter and in spring the fall in one day often exceeds the mean for the month. At both Beersheba (9·3 inches) and Jericho (5·9 inches) the 24-hour maxima equal or exceed the monthly mean in each month except that of maximum fall. The sudden and intense downpours in the desert, which send torrents of water raging down the wadis, sweeping away soil, crops, and livestock, have to be seen to be appreciated. In most of the areas with under 12 inches annual rain there are usually less than 20 rain-days in the year.

The Bible is full of references to man's anxiety concerning the rainfall and his troubles in times of drought, and it may be useful to reiterate the conclusion, without recapitulating the arguments, so ably reasoned by J. W. Gregory [3] that "all through historical times the climate has been essentially the same as it is now."

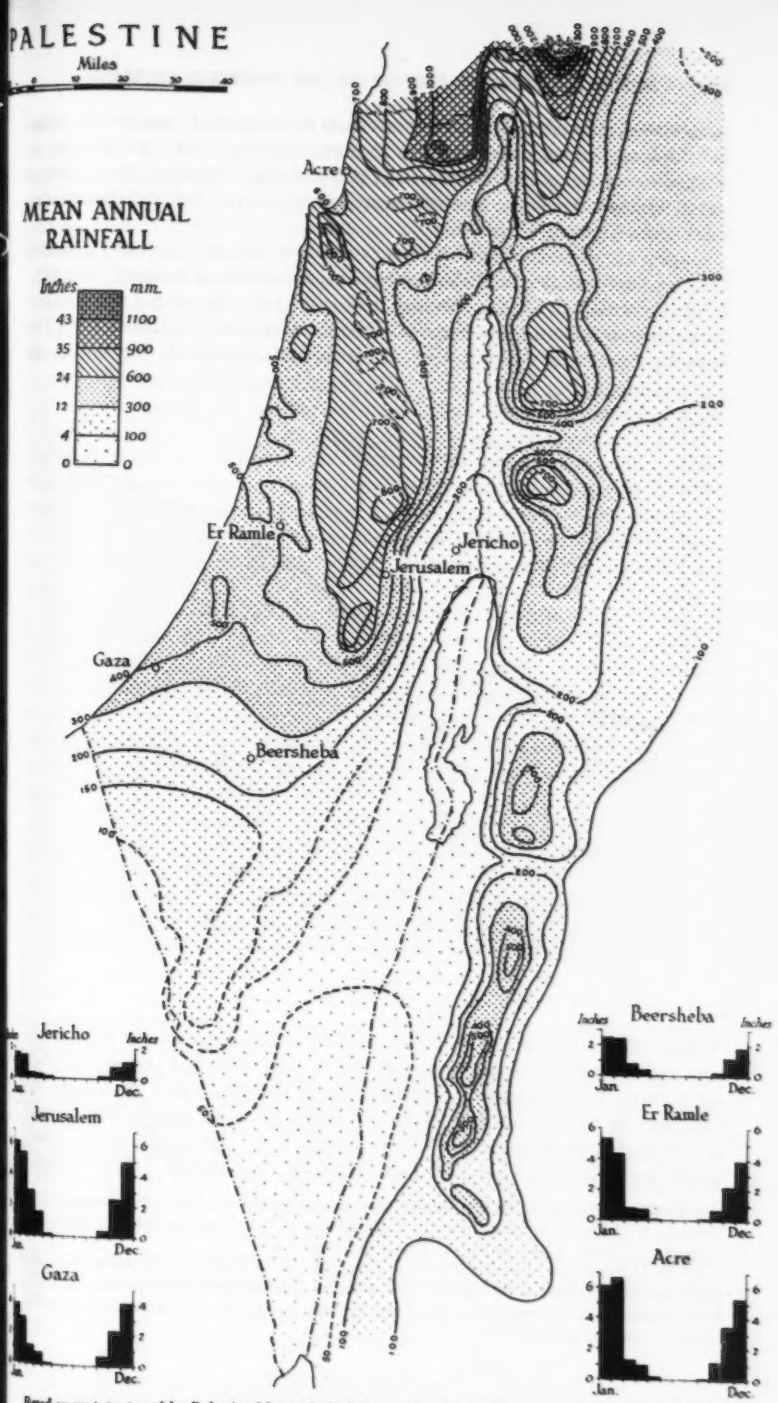
The major problems of Palestine, as of many countries,[4] are bound up with considerations of population, especially the question of what numbers the

[1] 'Maps relating to the Report of the Anglo-American Committee of Enquiry regarding the problems of European Jewry and Palestine,' map No. 2. (Supplement to Cmd. 6808.) London: H.M.S.O., 1946.

[2] See 'Rainfall Map of Palestine, Transjordan, southern Syria, Southern Lebanon, average for the period 1859–1938,' by W. D. Ashbel; issued by the Hebrew University Press with the aid of the Jewish Agency for Palestine.

[3] J. W. Gregory, "Palestine and the stability of climate in historic times," *Geogr. J.* 76 (1930) 487–94, and "Is the earth drying up?" *Geogr. J.* 43 (1914) 152–62.

[4] G. C. L. Bertram, "Population trends and the world's resources," *Geogr. J.* 107 (1946) 191–210.



Based on map prepared by Palestine Meteorological Service for the Anglo-American Committee of Enquiry

Figure 2

country can maintain. The matter has been the subject of much study, wishful thinking, propaganda, and speculation, and this must inevitably be so while the problem is over-shadowed by political considerations. It is therefore worth while to review the facts of the present and recent past and then to consider some future probabilities.

During the British administration population data of increasing accuracy have become available, and the forthcoming third census is eagerly awaited.[1] While the broad division is between Jews and Arabs, the official classification is by religious communities because of the social structure of the country. The Jews by "nationality" and religion are almost coincident, but the Arabs

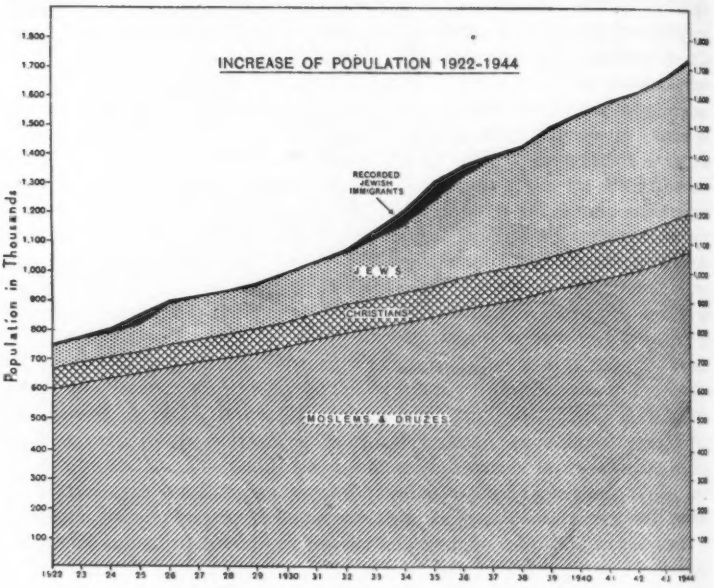


Figure 3

include other religious groups beside Moslems. Moslems are the largest community, and include some pure Arab Beduin, a fascinating people habitually antipathetic to enumeration, largely living in the desert and its fringes and estimated in 1931 to number 66,300, although there are reasons for thinking they considerably exceed this.[2] There are also a few thousand Druses, mostly in the north of the country, who are Arabs by "nationality." The Christian

[1] Throughout this paper the author has drawn freely on the two volumes of the 'Survey of Palestine prepared for the information of the Anglo-American Committee of Inquiry,' 1946. Government of Palestine, 1946.

[2] The Department of Statistics of the Government of Palestine has recently made a fresh enumeration of the Beduin of the Beersheba District and found 90,000, excluding 6000 in the town of Beersheba. The total Beduin population of Palestine is therefore between 120,000 and 130,000.

community, 80 per cent. Arab, is a small minority of considerable importance in certain localities. The most outstanding fact concerning the population is its phenomenal increase during the years of British rule (Fig. 3). Accurate data are not available for previous periods, but there is ample evidence that the population had remained fairly stable for a long time. Then, in two decades of British rule, it doubled.

This increase was quite unprecedented and has been at an accelerating rate. The twin causes have been Jewish immigration and the natural increase of the indigenous population. The result has been an increase of the total population from 752,000 in 1922 to 1,740,000 in 1944. The Jews have increased from 12·9 per cent. of the settled population in 1922 to 32·6 in 1944, when they totalled 554,000; 74 per cent. of their increase was due to immigration. In the same period the Moslems almost doubled, but only 4 per cent. of their increase was due to immigration. The recorded Jewish immigration shows marked fluctuations due to political events in the countries of origin. Definite waves of refugees, first from Russia and Poland and later from Germany and Austria, have swollen the irregular stream of Zionists and others who have come to Palestine as a result of mixed incentives, including idealism and economic depression.

The map of Population 1944, made by the Research staff of the Anglo-American Committee,[1] shows the population of each village and town, distinguishing the religious groups. While it was impossible to show the nomadic population, the map emphasizes the uneven distribution and reveals the emptiness of the desert areas. The Southern Desert, the Wilderness, the lower Jordan valley, and the coastal sand dunes are areas which repel population except for a few hardy Jewish settlements of a distinctly experimental character.

But the most striking facts are the size of the largest towns and the distribution of the Jewish and Arab communities (Fig. 4). Palestine is primarily a land of villages with four large towns and about a dozen small ones. In addition to the four large towns of Tel-Aviv (167,000), Jerusalem (157,000), Haifa (129,000), and Jaffa (94,000), twenty others rank as municipalities, but only twelve of these exceed 10,000 and the largest of them, Gaza, has but 34,000 inhabitants, while a number are little more than large villages. In the country as a whole, 50 per cent. of the population lives in villages, a much smaller proportion than ten or twenty years ago, although the actual numbers have increased considerably.

A separate examination of the two principal communities reveals some interesting facts. The Jews, in spite of the increased number of agricultural settlements established in furtherance of the policy of "close settlement on the land," [2] are largely an urban population. 329,000 or about 60 per cent. live in the three chief towns and only 25 per cent., slightly less than in 1931, in villages as compared with 70 per cent. of Moslems. The Jewish urbanization has accelerated rapidly, their town population increasing threefold between 1931 and 1944, although the Palestine Jews have always tended to concentrate in large towns. The percentages of the Jewish population in towns of over

[1] Supplement to Cmd. 6808, map No. 3.
[2] Mandate for Palestine, Article 6.

POPULATION 1944
Scale for centres of over 2000
175,000
50,000
2,000
100,000
10,000
1000 - 2000 persons
500 - 1000
250 - 500
under 250
JEWS
ARABS
Miles
0
10
20
30
40

Figure 4

45,000 inhabitants in 1922, 1931, and 1944 respectively were 72, 69, and 64·5, the corresponding Moslem figures being 7·4, 10·0, and 11·4. The Jews, in short, are fundamentally an urban people and in Tel Aviv have set a record for urbanization and "New Town" growth. In 1910 Tel Aviv was a suburb of Jaffa with a mere 500 inhabitants, in 1922 it had 15,000, in the next nine years it trebled and, continuing at this rate, was by 1944 the largest town with 167,000 inhabitants, the Jewish metropolis, the commercial centre of the country, a coastal city but not a port.[1]

This modern urbanization reveals tendencies analogous to those of Western European countries,[2] tendencies which, while also perceptible in Syria and Lebanon and to a lesser extent in Egypt, are not yet common in other lands of the Middle East. Such developments are accompanied by political, social, and economic changes associated with industrialization and capitalization which represent a notable revolution in countries hitherto essentially agricultural.

The Arab pattern is an almost complete contrast. The hill areas are predominantly Arab and, while the northern coastal plain and the plain of Esdraelon, formerly malarial, are predominantly Jewish, there is a notable line of large villages in, or fringing, the maritime plain, where the increase of Arab rural population has been greatest owing to better economic and social conditions. The Arabs, especially the Moslems, are still predominantly an agricultural people, 70 per cent. dwelling in villages. There has been a slight tendency to urbanization by a movement into such towns as Haifa, Jaffa, Gaza, and Jerusalem where industrial or commercial activities have expanded; but it is remarkable that for the last twenty-two years the Moslems have represented an almost constant proportion of the urban population.

The problem of the future trends of population is naturally one which has attracted much attention, especially because of proposals to increase immigration into a land which already shows some signs of relative over-population and which is now increasing its population at a higher rate than any other in the world. Methods of forecasting which are valid elsewhere are difficult to apply to Palestine because of the very variable composition and irregular age distribution of a demographically heterogenous population.

The Jews, as a result of immigration, have a high proportion of people in the central ages (54 per cent. of immigrants in the last decade were between the ages of 15 and 34), and a scarcity of old folk is most noticeable wherever one travels in their towns and villages. Marriage is practically universal and a much greater proportion of the fertile period is spent in marriage than is customary in Europe. The birth rate, which exceeds 30 per thousand, is high by European standards, but is of course influenced by age structure (as well as by economic conditions and even propaganda) and varies greatly according to the land of origin. It is lower among those from West and Central than from Eastern Europe, and highest among Jews from Iraq and Iran—similar in fact to Arab rates. The crude death rate of 7 or 8 per thousand is the lowest recorded in the world, but this is because of the abnormal age structure; a

[1] A small lighter basin was constructed ten years ago, but it suffers from even more disadvantages than the port of Jaffa.

[2] A. Bonné, 'The economic development of the Middle East. An outline of planned reconstruction after the war,' London, 1945.

corrected figure would give 15 or 16, which is still very low. The main reason for this is the great reduction in child mortality, due to the introduction of improved health services and standards and the widespread supervision of children by welfare centres. As a result of these factors, the rate of natural increase of 2 per cent. per year is very high compared with European rates, most of which are below 1 per cent., but it is lower than the Moslem rate of 2·6.

For the future it is difficult to envisage any improvement in the Jewish rate of natural increase by a further substantial decline in the mortality rate, but the fertility rate is more difficult to forecast because of the lack of reliable data. It may well be that the present high rate, due to a favourable age structure, will not be maintained.

The Moslem population shows the two general characteristics of oriental people: a high proportion of children, accentuated by the high birth rate and low child mortality rate in the last decade or so, and a low proportion of old folk. As with the Jews, marriage is almost universal and at very early ages; the average age for women is under 20 and for men is 24, and as remarriage of widowed and divorced women is frequent "Palestine Moslems are to be counted as among the most marriage-loving populations in the world." [1] It is therefore not surprising to find a birth rate of over 50, a fertility rate which has increased to over 7 children per mother, and a net reproduction rate which, doubtless improved by the general rise in Moslem standards of living, is now, at 2·4 or more, double the Jewish rate. The mortality rates (especially infant mortality rates) have, unlike those in neighbouring lands, decreased remarkably in recent years, from over 30 to 18·7 in the last fifteen years, an improvement which in Europe took more than half a century. In short, in the favourable conditions of the last two decades, the natural increase of the Moslems has been phenomenal and has resulted in a very marked increase in such areas as the coastal plain, to which there has been internal migration.

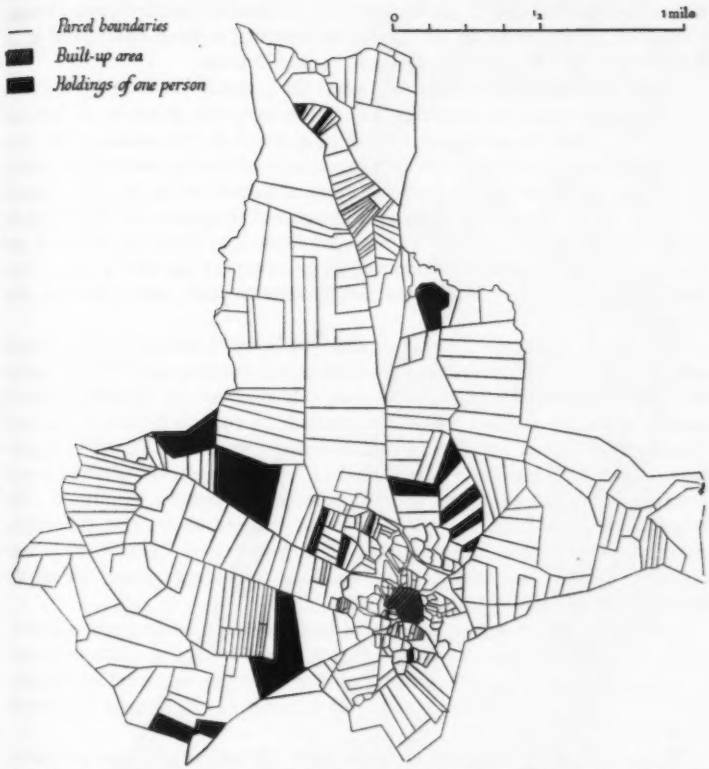
For the future, it seems that no further increase in Moslem fertility is likely or even possible, but that some reduction is more likely since the better classes in the towns have already shown signs of lower fertility. Mortality rates may decline somewhat, but spectacular improvements are improbable.

The problem of land tenure in Palestine is an extremely complicated one, with an intricate system inherited from Ottoman times and largely deriving from a feudal social structure. Practically all the agricultural land is *miri* land, which reverts to the state, but individuals have rights of use and occupation, and may sell, mortgage, or lease, but may not bequeath. It is common among Arabs for rent to be paid in kind, the landlord normally doing nothing in return: an unsatisfactory system which is widespread in the Middle East. In the majority of Arab villages the cultivated land is held in *masha*, a system of joint ownership whereby individuals have claims to an undivided share in all the land and own no specific piece. Every two to four years the plots are changed. The system is pernicious.

The hereditary system of division often results in one man's share being very small. A holding usually consists of a number of fragments of land, dis-

[1] "Survey of social and economic conditions in Arab villages, 1944," *Gen. Mon. Bul. of Current Statistics*, July 1945. (Published for the Government of Palestine.)

persed in various parts of the village in order to share lands of varying quality (Fig. 5). The cultivator thus cannot enjoy the full benefits of consolidation, mechanization, irrigation, and improvement; nor is he encouraged to plant fruit trees or even to manure the land. The average number of fragments per holding in a recent sample of five villages was found to be 9, but varied with the size of the holding; holdings of 5–10 acres had about 12 fragments, those



After map prepared by Department of Statistics, Government of Palestine, published in Gen. Mon. Bul. of Current Statistics, Dec. 1945.

Fig. 5. Fragmentation and dispersal of holdings in Arab village

of less than $2\frac{1}{2}$ acres averaged 5 fragments. Joint ownership of parcels is not uncommon and aggravates the problem. In the sample survey there was an average of three co-owners per parcel. Hence the truth of at least half the saying, "Rights in land and wrongs to women are the worst of village evils."

Some of the evils of the system can be solved by land settlement. The Turks had a system of land registration which was incomplete, chaotic, and

obsolete; the British introduced a thorough system of Land Settlement linked to a cadastral survey involving registration of title to land on the Torrens system, which enables all parcels of land to be identified on the ground and in the plans and registers. It has proved a slow and costly process, but of great benefit to the country as a whole, for by securing a clear title to land and encouraging consequent development it removes one of the two greatest obstacles to permanent improvement, the other being land tenure. It has also helped to settle the vexed question of which tracts of land are State Domain, about 600 square miles in all. So far settlement has been completed in the fertile plains and is now in progress in some hill areas.

Settlement has undoubtedly facilitated the purchase of land by the Jews, who now own about 370,000 acres (Fig. 7) but have only begun to use less than half. The total area owned is a small proportion of the country, but comparison of Figs. 7 and 10 shows that it is almost all land of the highest quality. More than half the Jewish land has been acquired by the Jewish National Fund at an average cost, including drainage and irrigation, of about £32 per acre. It is inalienable, let only to Jews, no Arabs may be employed on it, and the rentals charged are uneconomically low (none for the first 5 years, 1 per cent. of the assessed economic value for the next 10 years, and 2 per cent. after 15 years).

The steady increase of land purchase by Jews, together with the rapid natural growth of the indigenous population, was tending to severe congestion and depressed standards of living and to a problem of landless Arabs in certain areas. An attempt was therefore made in 1940 to protect Arabs from the effects of further transfers in certain areas by the Land Transfers Regulations which prohibited the sale of land to Jews in one zone, allowed it only conditionally in another, and allowed unrestricted transfer in a third. The Regulations have been the subject of much controversy, and the Anglo-American Committee recommended their withdrawal because they were opposed to any discriminatory restrictions, including those against the employment of Arabs on Jewish lands.

Agriculture and related problems of land have received attention from so many experts [1] and are so complex that it would be out of place to attempt to mention more than a few salient points concerning an aspect of Palestine which has undergone great changes as a result of the impact of western ideas on eastern conditions.

There are now three distinct main types of agriculture: the indigenous farming, modern intensive farming, and citriculture. The first is largely a self-sufficient peasant agriculture, based on a two-year rotation of winter crops of wheat and barley and summer crops of millet or sesame, sown after repeated ploughing of winter fallow. The system is dictated by the rainfall regime and the crops depend on the rain, the corn crops especially requiring the "former" rains for germination and the "latter" rains to swell the grain at the milky stage of growth. In the semi-desert of the south no summer crop

[1] See, for example, F. A. Stockdale, 'Report on a visit to Palestine and Trans-Jordan.' Colonial Advisory Council Paper No. 247. London, Colonial Office, 1935; and B. A. Keen, 'The agricultural development of the Middle East.' A report to the Director General, Middle East Supply Centre, May 1945. London, H.M.S.O., 1946.

CULTIVATION
After J. Weitz and Z. Lifshitz
Compiled from Survey of Palestine
1:100000 Fiscal Survey 1933-34
Over 20% cultivated
Less than 20%
Uncultivated
Miles
0 10 20

Figure 6

is possible, and barley or wheat, alternating with fallow, is grown by a nomadic or semi-nomadic people who harvest the crop in the spring and then take their animals to graze on lands elsewhere. This indigenous extensive system is well adapted to the support of a relatively stable population and is little affected by the trend of major economic fluctuations. Livestock provide milk and meat; eggs, honey, and vegetables are produced, and olive oil furnishes a valuable food and cash crop which can withstand long storage. The general methods of agriculture change slowly. The traditional wooden plough, drawn by ox, donkey, or camel, is ideal for ploughing narrow terraces and stony hillsides, and its shallow cultivation minimizes the loss of moisture by evaporation.

Table I.—Area and value of chief crops, 1944–45 (in thousands)

	Arab		*Jewish*		*Total*	
	Acres	£	*Acres*	£	*Acres*	£
Grain	1038	4403	54	497	1092	4900
Vegetables	60	5113	10	1746	70	6859
Fodder	6	157	30	951	36	1108
Fruits (excluding citrus) ..	89	3139	9	1380	98	4519
Olives	148	3320	2	53	150	3373
Melons	30	970	1·5	84	31·5	1054
Citrus (1939)	37	1600	38	2400	75	4000

But the system has little flexibility, and the evils of land tenure and fragmentation are acute. In the Hills there is virtually no prospect of improvement by irrigation, and centuries of overstocking, uncontrolled grazing and overgrazing, especially by destructive goats, have dangerously intensified soil erosion. There is a crying need for afforestation of the steeper hillsides which would, as small government experiments have shown, quickly reduce run-off, increase percolation, and prevent springs from drying up, and at the same time would re-create soil and provide both firewood and areas for regulated grazing. But the pressure of population on land is so great that the cultivator is naturally opposed to the withdrawal of even the poorest land from cultivation or grazing; and so the problem of erosion grows. A recent study in the Nablus–Tulkarm valley [1] showed that 62 per cent. of the steep slopes (4½°–14°) and 80 per cent. of the precipitous slopes (over 14°) were under crops requiring ploughing, and only 14 and 8 per cent. respectively were sufficiently terraced to prevent soil wash. Stones are abundant but the capital and incentive to build them into terraces is lacking and, while many fine terraces are to be seen, their absence or neglect is very widespread.

There is an urgent need for the control of grazing and for the improvement of herbage, especially by the introduction of drought-resisting plants which would enable stock to be kept without injury to the land.[2] Hill agriculture especially requires diversification by increased culture of fruits, such as olives, figs, grapes, apricots, and almonds. The olive is already the principal

[1] Government of Palestine, Soil Conservation Board, Bulletin No. 1.
[2] F. A. Stockdale, *op. cit.*, p. 48.

Figure 7

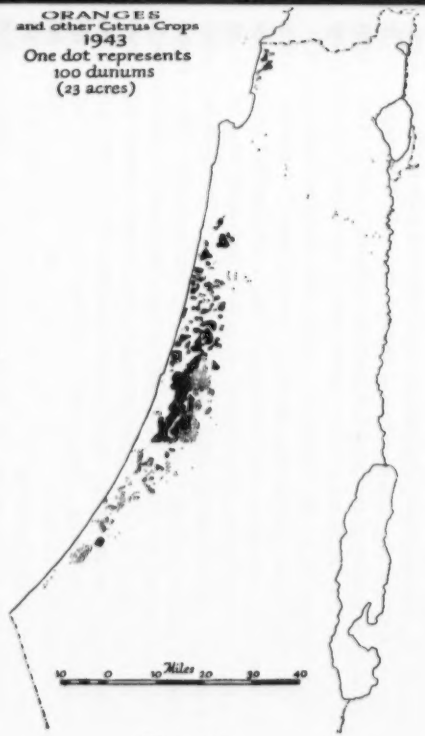


Figure 8

Figure 9

fruit tree of Palestine and is almost entirely cultivated by Arabs (Fig. 9). The vine is a crop which is increasing in extent and profitability, and the fig, also largely an Arab crop, flourishing in arid and rocky situations, is being increasingly planted. Almonds, walnuts, apricots, and peaches are as yet lesser crops with various merits and problems.

The second main type of farming is an intensive system based on irrigation and the need to supply the growing urban population. Introduced by the Jews, it has been successfully followed by Arabs in suitable areas. It includes dairying based on irrigated fodder crops (and still comparing very unfavourably with overseas production), poultry, fruit, and vegetables, with some cereals. It is a highly capitalized and mechanized agriculture, largely based on the special Jewish settlement on the land. It has raised the productivity of the land but has made it less self-sufficient, and a very high proportion of the foodstuffs of Palestine continues to be imported. The system is an interesting piece of planning, aimed at a marriage of agriculture and industry, with the standards of living of the agriculturists not dictated by the economics of farming but fixed by the community and the system evolved to sustain it.[1] The leading economists of the Jewish Agency have stated that "It is no exaggeration to say that the actual process of colonization was financed mainly through the Jewish public funds without the expectation of a reasonable return." [2]

The third type, citriculture, except for some eighteenth-century plantations, is essentially a modern achievement of a highly mechanized and capitalized agriculture employing hired labour. It is largely concentrated on the light soils of the central coastal plain, and it increased from less than 8000 acres in 1923 to 76,000 in 1939; this is probably the optimum area. The majority of the groves are of the Shamouti or Jaffa orange, but there is a small acreage of Valencia oranges as well as some grapefruit on heavier soils and some lemons. The enterprizes are mostly small private farming units of under 10 acres using cooperative marketing. The industry is almost evenly divided between Jews and Arabs who combine on the Citrus Marketing Board to attempt to meet the many problems arising from selling a crop, of which the bulk is a thick-skinned fruit which packs very uneconomically, relying almost entirely on overseas markets (more than 70 per cent. comes to Britain) and with a shorter shipping season than that of any other citrus exporter. It is considered by many, including Horowitz and Hinden,[3] that the industry has suffered from over-expansion because of the "pressure of investment-seeking capital."

In a country with such contrasts, where there is acute land congestion and at the same time certain limited prospects of land improvement, it is not surprising that much attention has been given to the question of the "lot viable" or subsistence area. The Royal Commission discussed the problem of subsistence areas very fully and there is little to add to its masterly review,[4] which pointed out that the hill lands especially were already congested and that there was then no satisfactory basis for advance estimates of either the total cultivable area or the amount required by each cultivator. The Rural Property

[1] B. A. Keen, *op. cit.*, p. 25.
[2] D. Horowitz and B. Hinden, 'Economic survey of Palestine,' p. 57, Tel Aviv, 1938.
[3] *Ibid.*, p. 69.
[4] 'Palestine Royal Commission Report,' chap. IX. London, H.M.S.O., 1937.

Tax records show the area cultivated and particulars of its quality for all the lands north of Beersheba. Detailed plans show the various types of land, the extent of its cultivation and, for the sixteen tax categories which are related to approximate yields, the division into blocks of similar productivity value. A crude index is therefore available showing, for example, that forty times as much of the poorest cultivated land is required for a "lot viable" as of land under citrus or bananas.

As a fresh contribution to the wider understanding of the problem, the research staff of the Anglo-American Committee compiled a Tentative Land Classification Map of Palestine,[1] using all available data, such as the village statistics concerning crops and categories, various published and unpublished maps and plans, oral and documentary testimony of various government departments and officials and other local experts, as well as extensive first-hand studies on the ground and from the air. It was found necessary to distinguish ten classes of land: three of Good, three of Medium, and four of Poor Quality (Fig. 10). Table II gives the type and dominant use of land in these classes. The map published in the supplement to the Committee's report shows also the land now partly irrigated and that not irrigated but well situated for water supplies (Fig. 12).

The Palestinian unit of land is the dunum, or 1000 square metres (about ¼ acre). Subject to certain limitations, the tax categories can be used to express the productivity of any dunum of land in terms of a "standard dunum," taken as category 12, by dividing the tax rate of the one by the other; thus comparisons between dissimilar land may be made. After the compilation of the Committee's map, the Department of Statistics of the Government of Palestine investigated the various tracts comprising each class, and, ignoring land under citrus and bananas, expressed the results in terms of the standard dunum and then expressed the relative productivity of the classes, taking Class 4—the typical hill lands—as a standard of 1. The results are shown in Table III.

Everyone who has studied the problem agrees that in irrigation lie the chief hopes of considerable agricultural improvement, for only a reliable supply of water available all the year round can enable more than a limited range of seasonal crops to be produced. The Royal Commission ably summarized the matter by saying: "It is on the extension of irrigation, combined with the regularized control of the water resources of the country by Government, that reliance must mainly be placed for any marked increase in the productivity of the land."[2]

As yet, unfortunately, there is no legislation in Palestine to make the principles of water ownership conform to good irrigation procedure. Existing water rights are a very complex inheritance from Ottoman law, which, while regarding the State as owning all surface water, allowed the right to use water to land which had immemorially received it. Recently there has been some tendency by interested parties to dispute the public ownership of springs and rivers and to treat water rights as if they were susceptible of absolute ownership. Partly in consequence of this, the Government has attempted to

[1] Supplement to Cmd. 6808, map No. 5.

[2] *Op. cit.*, p. 221.

Table II.—Land classification

	Dominant use
A. GOOD QUALITY LAND	
1 HIGH CLASS LAND, level or gently undulating with fertile soils and an adequate water supply (Plate 2).	Intensive citrus, fodder and vegetable cultivation.
2 GOOD LAND, with loamy soils, similar to (1), but with lower rainfall (Plate 4).	Citrus, cereals and vegetables.
3 GOOD LAND, with deep alluvial soils, suitable for a wide range of ground crops and, where irrigation is available, for intensive farming (Plate 7).	Cereals, fodders and deciduous fruits.
B. MEDIUM QUALITY LAND	
4 UPLANDS OF LIMESTONE, with steep and terraced slopes, much shallow soil and rock outcrop, with tracts of deeper soils in valleys (Plate 6).	Cereals, olives, vines and deciduous fruits.
5 UPLANDS, similar to (4) but with more bare rock, steeper slopes and less cultivable land.	Cereals, olives, vines and deciduous fruits.
6 SEMI-DESERT LOWLAND, with good loess soils, but cultivation limited by low and very variable rainfall.	Barley, wheat and melons.
C. POOR QUALITY LAND	
7 LOWLANDS, with limited seasonal crops and grazing; some broken land and some highly saline soil and extensive stretches of cultivable land if irrigated (Plate 5).	Seasonal pasture with patches of irrigation on favourable sites.
8 DRY ERODED HILLS	
(a) Northern Belt, with sufficient moisture for patches of cultivation where sufficient soil.	Seasonal grazing and patches of cultivation.
(b) Wilderness, with very arid conditions (Plate 1).	Limited seasonal grazing.
9 SOUTHERN DESERT OR NEGEB, deeply eroded uplands and southern rift valley (Plate 3).	Desert with scanty patches of cultivation only when rainfall is sufficient.
10 COASTAL SAND DUNES.	

Table III

Class of land	*Relative productivity*
1	7
2	3·2
3	2
4	1
5	0·5
6	0·5
7	0·3
8	0·005

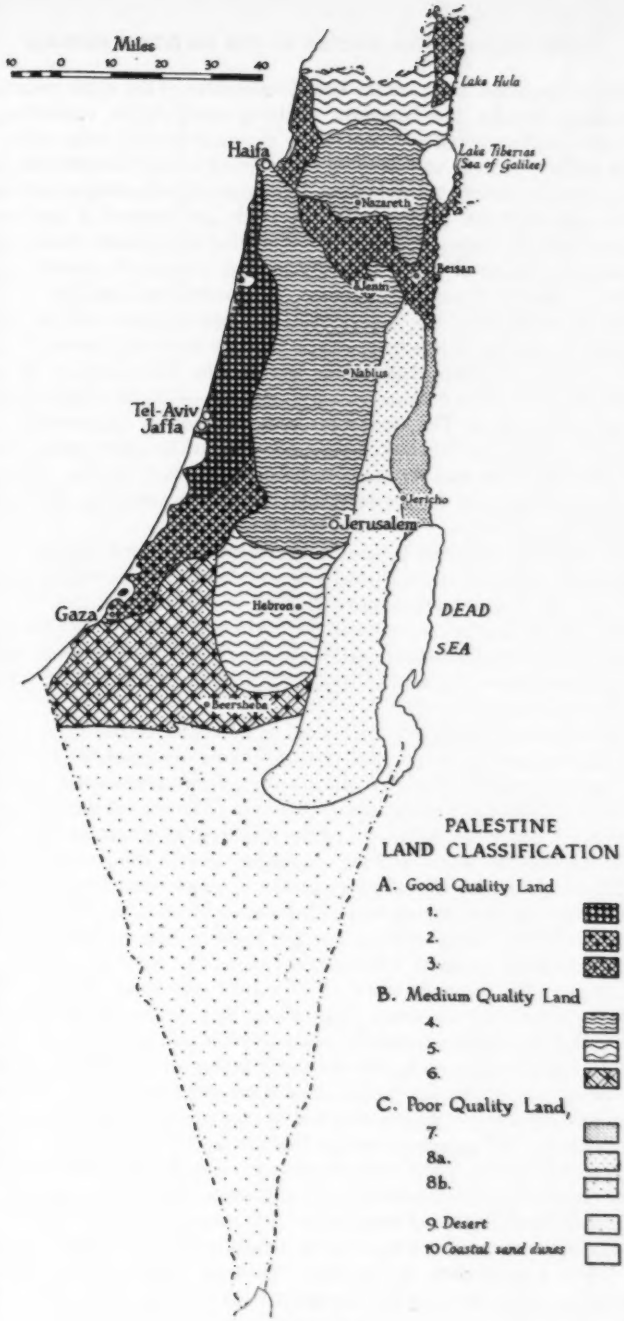

Miles
10 0 10 20 30 40
Lake Hula
Haifa
Lake Tiberias
(Sea of Galilee)
Nazareth
Beisan
Jenin
Nablus
Tel-Aviv
Jaffa
Jericho
Jerusalem
Gaza
Hebron
DEAD
SEA
Beersheba
PALESTINE
LAND CLASSIFICATION
A. Good Quality Land
1.
2.
3.
B. Medium Quality Land
4.
5.
6.
C. Poor Quality Land,
7.
8a.
8b.
9. Desert
10 Coastal sand dunes

Figure 10

introduce legislation to secure the best development of the water resources by controlling drainage and irrigation, deciding water rights, controlling surface water, and studying and controlling the underground water table.

The surface water is now deemed to be vested in the Government, but so far the draft law for its control has not been enacted, and owing to unfortunate Jewish opposition the proposals for the study and control of underground resources have not proceeded very far. The vital information concerning the fluctuation of levels in wells, seriously needed in order to decide the best method of control of water exploitation, is therefore not available.

That investigation of the behaviour of the underground water is essential as a preliminary step to control is shown by what is already known of the fall in the level of the water table in the last decade. Near Haifa it has fallen 13 feet and is now below sea-level, with a dangerous threat of penetration by salt water. In parts of Tel Aviv where water is supplied from shallow wells, sea water is already in some over-pumped wells, while a few miles inland in the Lydda–Rehovot area levels in wells have dropped 12 feet. Elsewhere there is doubtless room for a considerable increase in pumping, but exploitation must be controlled.

Data are being collected by the Government on various aspects of water supply, such as run-off and the possibilities of dams. It is surveying well and boreholes, carrying out exploratory drilling, and is studying the "duty" of water (the amount of water required for various crops) and the problems of salinity. Such investigations are essential before major schemes are attempted, especially in a country where natural conditions often handicap rather than help the water engineer.

As shown in Fig. 11, the average annual rainfall of the country (ignoring falls of less than 10 inches) is about 7000–8000 million cubic metres, but rather more water enters the country—about 10,000 million cubic metres—because of the contribution from the Jordan springs in Syria. The central mountain range divides the country unevenly, and of the total rainfall about two-thirds falls towards the Mediterranean and the remainder towards the Jordan and Dead Sea. About two-thirds of the precipitation is evaporated from the soil or transpired by unirrigated vegetation, but the proportion of actual run-off is phenomenally low, being estimated at 300 million cubic metres to the west and 180 million to the east. This does not mean that the wadis do not carry down great rushes of water, but their flow is of very short duration. Much more penetrates into the rocky hills—about 1400 million cubic metres, of which about 800 drain westward—while another 400 million cubic metres penetrate the maritime plain. Of the water falling in the hills, 345 million cubic metres on the west and 300 on the east are estimated to feed springs and rivers, of which about 15 on the west and 85 on the east are used for irrigation while another 15 are pumped near the foothills on the east for the same purpose. The remainder of the water flowing towards the Mediterranean finds its way through blocks of sunken mountain strata, below the important impermeable layer of Saqia and other beds which retains the water in the coastal plain substrata and isolates it from the mountain underground water at a lower level. While a proportion of the latter—perhaps a fifth—is too saline for irrigation, it should be possible to exploit most of it by semi-artesian wells

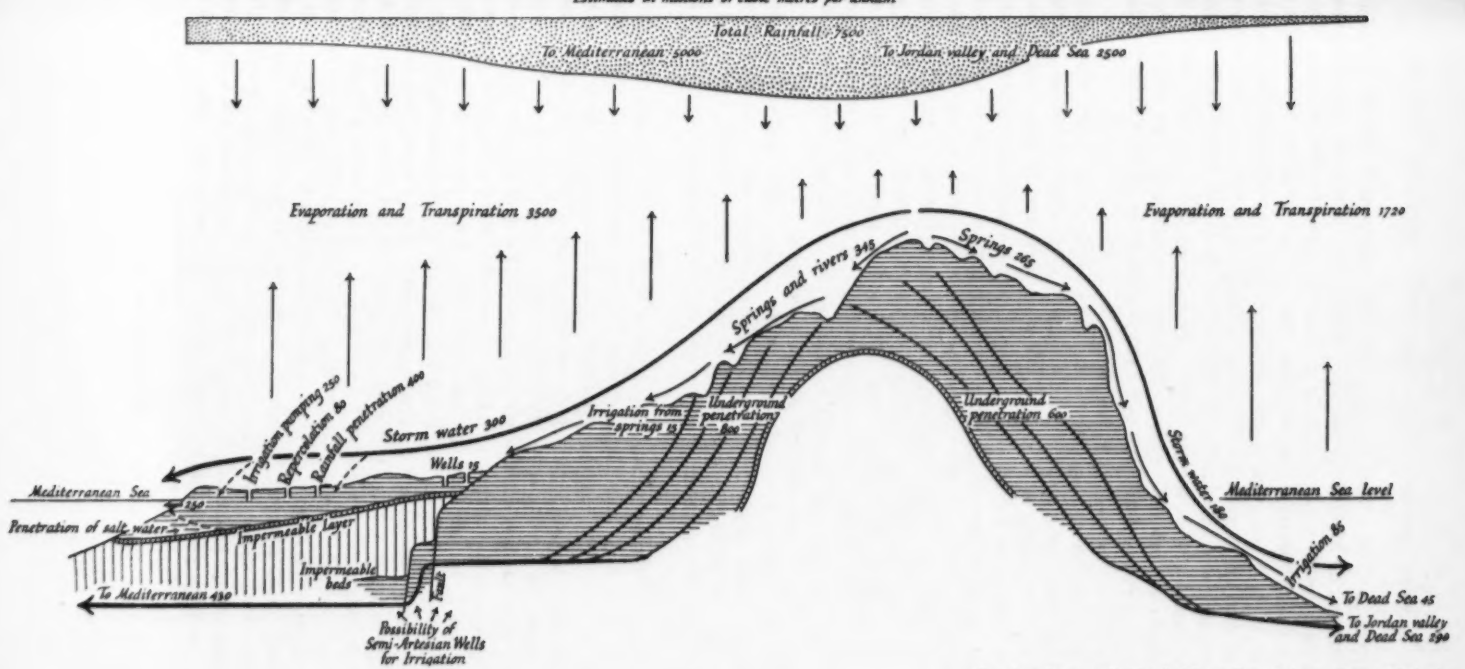

Hydrological Cycle of Palestine
Estimates in millions of cubic metres per annum
Total Rainfall 7500
To Mediterranean 5000
To Jordan valley and Dead Sea 2500
Evaporation and Transpiration 3500
Evaporation and Transpiration 1720
Springs and rivers 345
Springs 245
Irrigation pumping 250
Reproduction 80
Rainfall penetration 400
Storm water 300
Irrigation from springs 15
Underground penetration 600
Underground penetration 600
Wells 15
Storm water 180
Mediterranean Sea level
Mediterranean Sea
250
Penetration of salt water
Impermeable layer
Impermeable beds
Fault
To Mediterranean 430
Irrigation 85
To Dead Sea 45
To Jordan valley and Dead Sea 290
Possibility of Semi-Artesian Wells for Irrigation
Based on data supplied by the Water Commissioner, Govt. of Palestine

Figure XI

near the foothills, where the water in such wells rises to within 65–130 feet of the ground. In the maritime plain, about 400 million cubic metres replenish the underground water table in porous sand and sandstone rocks. About 250 million cubic metres of this is now pumped for irrigation on the plains, of which a third repercolates and, with a similar proportion of the mountain water used for irrigation, flows towards the Mediterranean. While the mountain water could be available for irrigation up to its full annual capacity, sufficient must be left of the 250 million cubic metres flowing slowly through the younger rocks below the plain to enter the Mediterranean to prevent the trend becoming reversed and the salt water invading the wells, a disaster which cannot be remedied once it has occurred.

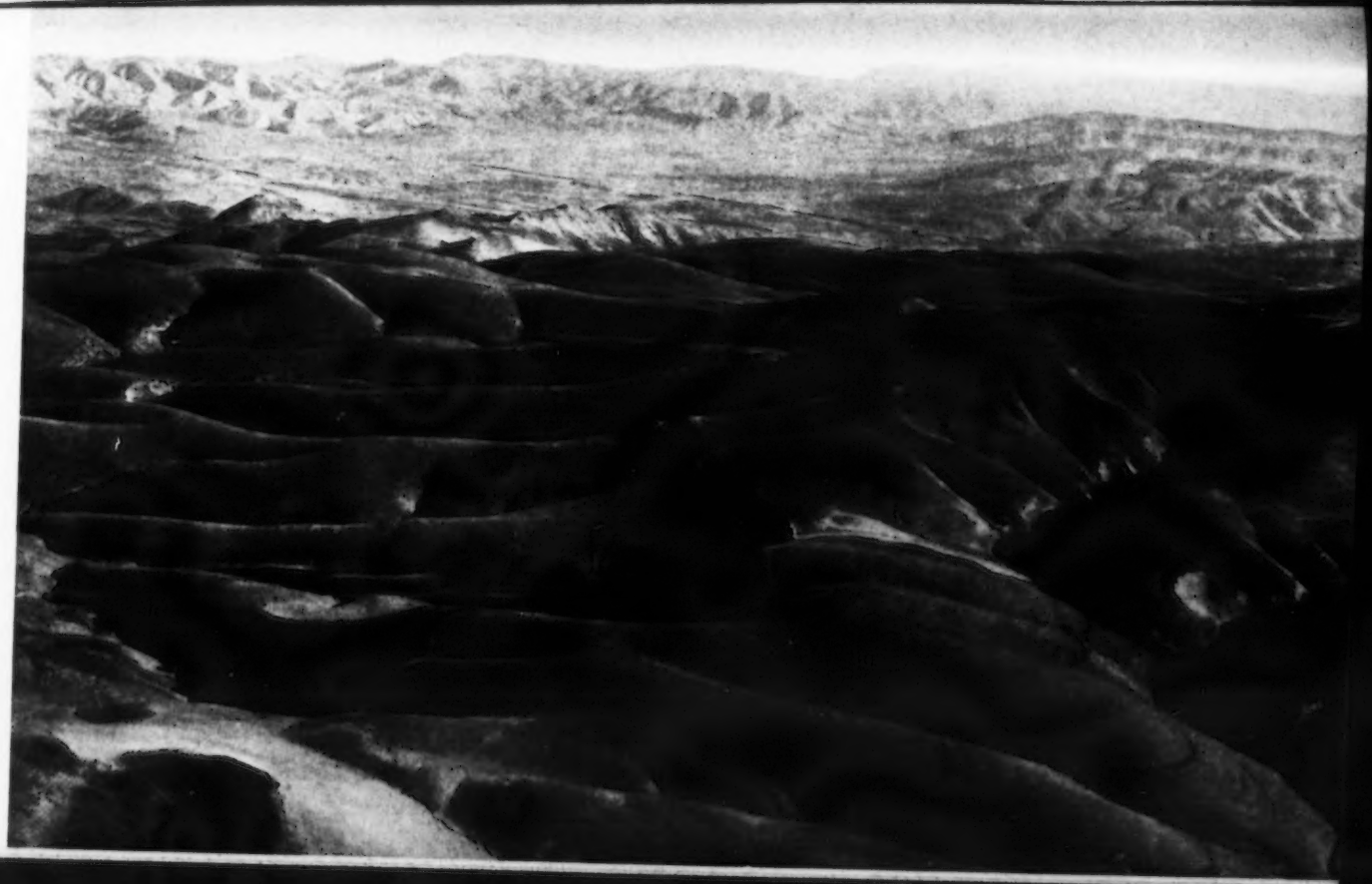
Consideration of these facts makes it clear why the Royal Commission asserted that "Irrigation from wells is, and is likely always to remain, the chief source of irrigation in Palestine."[1] The use of reservoirs for irrigation raises great difficulties. Owing to the very porous nature of the limestone rocks which compose most of the hill areas, the construction of dams is likely to be a very difficult and expensive means of utilizing the very irregular flow of flood water. An experimental dam and reservoir in the Beersheba area showed that 93 per cent. of the rain of the catchment area was absorbed into the soil, 7 per cent. reached the reservoir, but only one-half per cent. of the total was retained. Waterproofing of reservoirs would be a costly and expensive process, and the very irregular flow of the wadis would necessitate extravagantly large dams to hold a reasonable proportion of the water.

The problem of the use of saline water is a very serious one, as Reifenberg[2] and others have pointed out, but experiments seem to show the possibility of getting high yields of crops with saline water if certain chemical fertilizers are employed. The problem of saline soils such as those of the lower Jordan is a different one.

The general conclusion to which one is forced is that, in spite of the claims of propagandists, Palestine is very badly placed for irrigation. She contrasts very unfavourably with the major irrigation countries which, having large and assured supplies from rivers, have merely to organize the distribution of water. Palestine has but one small river (if we overlook the few miles of the Auja), and the Jordan is not merely very badly placed for irrigation but its flow is only 1 per cent. of that of the Nile and 3 per cent. of that of the Tigris or Tennessee. Whereas Egypt has 5000 cubic metres of Nile water per inhabitant and Iraq twice as much from its rivers, Palestine has about 1000 cubic metres from all its streams, springs, and water torrents, many of which are quite unusable.

There are about 112,500 acres now irrigated and about three times that area which could reasonably be irrigated out of a total of perhaps 820,000 acres of cultivated land in the plains. The chief irrigated area is the coastal plain, where wells 30–70 feet deep in the sandstone are used to irrigate about 82,000 acres. The inland plains of Esdraelon and Jezreel and a few smaller plains have smaller supplies, including both springs and boreholes. The Huleh basin is extensively irrigated with primitive channels and a big scheme has been prepared for its improvement. In the Jordan valley, south of

[1] *Op. cit.*, p. 253.
[2] Reifenberg, *op. cit.*



1. The Wilderness: softly dissected limestone country bordering the Rift Valley, too dry for settlement or cultivation

Phot. Jewish Agency

Phot. Jewish Agency

2. Citrus plantations on the coastal plain near Jaffa

Phot. Jewish Agency

3. Southern desert or Negeb

Tiberias, water is supplied by pumping from the river and from boreholes, and some from springs farther south in the Wadi Faria; at Auja and Jericho perennial springs permit such crops as bananas to be grown in tropical conditions. The hills offer very few opportunities for irrigation, except from a few small springs which supply much less than 1 per cent. of the tilled land. The area of deep loess soil in the Beersheba district has practically no irrigation water, though prospects would be excellent if water were available; the tragedy is that it is not. Boreholes have revealed no water that is not saline.

The prospect of making the desert bloom has long captivated both dreamers and engineers, and there have been various projects for irrigating large tracts of Palestine, especially the Jordan Valley, by impounding and canalizing the water in the upper reaches of the valley. Several of them have had associated projects for utilizing the difference in level between the Rift Valley and the Mediterranean for generating hydro-electric power, by conveying Mediterranean water by canal or tunnel and so earning revenue to pay for the project. The authors of some of the schemes claim that they may thus fulfil the prophecies of Ezekiel.[1] Various schemes may be practicable as engineering projects, but this does not mean that they are necessarily economic propositions when the probable cost of the work and of eliminating existing concessions is considered.

Recently Lowdermilk, in his book 'Land of promise,'[2] proposed a grandiose scheme for a Jordan Valley Authority. This combines an irrigation and power project to divert the waters of the Jordan and its tributaries to irrigate 158,000 acres in the valley and the plains of Esdraelon, Beisan, and other areas, and to carry Mediterranean water by canal into the Jordan Valley for the dual purpose of compensating the Dead Sea for its loss of sweet water and generating hydro-electricity by means of the 1200-foot drop into the Rift Valley. The scheme provides for various other ambitious projects which are not given in detail, including flood control and the reclamation of the Negeb by means of cheap power and by irrigation from artesian supplies and stored rain water. Lowdermilk suggests that his scheme is intended primarily to facilitate the settlement of millions of Jews in Palestine, and if Arabs do not like it "they could easily settle in the great alluvial plain of the Tigris and Euphrates Valley." [3]

The following year, 1945, a bold scheme which was largely an elaboration of the Lowdermilk plan was put forward by Messrs. Hays and Savage, American consulting engineers (Fig. 12). This consists of ten independent stages, beginning with damming the Hasbani river in the Lebanon to generate electricity to assist in developing the underground water of Palestine's coastal plain, and going on to carry water from the upper Jordan tributaries by a tortuous high-level canal to irrigate lands in the Huleh area, Esdraelon, and lower Galilee. Half the flow of the Yarmuk river would be diverted into the Sea of Galilee to prevent it from drying up and the other half used to irrigate

[1] See A. Hiorth, *J. Trans. Victoria Inst.* 55 (1923) 133–45, and 70 (1938) 126–52; and A. Homer, "Oil, potash and water-power in Palestine," *Crown Colonist*, 14 (1944) 679.
[2] W. C. Lowdermilk, 'Palestine, land of promise,' New York, 1944.
[3] *Op. cit.*, p. 178.

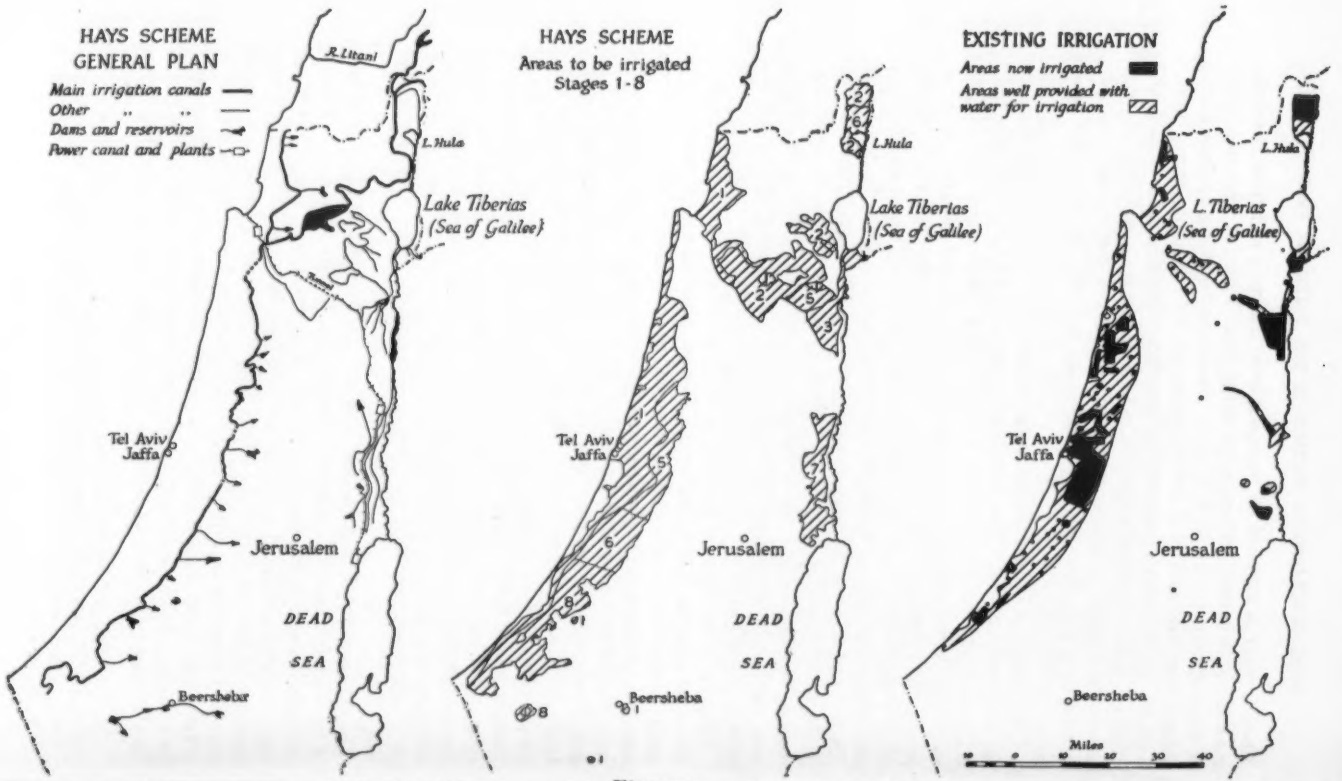

HAYS SCHEME
GENERAL PLAN
Main irrigation canals
Other " "
Dams and reservoirs
Power canal and plants
R. Litani
L. Hula
Lake Tiberias
(Sea of Galilee)
Tel Aviv
Jaffa
Jerusalem
DEAD
SEA
Beersheba
HAYS SCHEME
Areas to be irrigated
Stages 1-8
EXISTING IRRIGATION
Areas now irrigated
Areas well provided with water for irrigation
Miles

Figure 12

the land south of the Sea. The existing electric power plants of the Palestine Electricity Concession, which now use the Jordan water a little below the Yarmuk confluence, would have to be replaced, and for this and larger purposes a huge power canal would convey Mediterranean water from Haifa to the Jordan Valley, where electricity would be generated at two power stations and the water used to compensate the Dead Sea for the diverted Jordan water. The winter flow of the upper Jordan would be stored in a large reservoir in the great basin of the Sahl el Battuf in the hills of Galilee and conveyed by another tortuous canal to irrigate the plain of Jezreel and the central part of the coastal plain. The later stages would extend the irrigation southwards in the coastal plain, drain and irrigate the Huleh swamps, irrigate the lower Jordan from the dam on the central part of the river near Beisan, and store in dams the storm water of the wadis on the western watershed to swell the supply in the long canal from the Lebanon to the Negeb to water the Gaza area. The last two stages envisage carrying water from the Litani, in the Lebanon, as far as the Egyptian border by high-level canal.

The scheme, conservatively estimated to cost £50,000,000, is far from being the "blue print" which it has been claimed.[1] Its imaginative authors propose to irrigate 625,000 acres and to generate 660 million kw. of electricity as compared with the present 270 million. They presume that the many obstacles and difficulties will not prove serious. The cost of irrigation would average at least £80 per acre, about forty times the cost of the Punjab and Assuan schemes and six times the Godavari scheme.

The problems involved are not to be lightly disregarded. The scheme assumes the satisfactory cooperation of neighbouring countries, whose water supplies are to be used, and who have been provocatively described "as a seat of watersheds rather than as a seat of political entities." It assumes that arrangements can be made with existing concessions and other interests. Existing water rights cannot be roughly set aside as this would alienate Arabs who in any case might distrust a scheme directed primarily towards benefitting Jews. The scheme would require freedom from political as well as tectonic disturbances if its hundreds of miles of easily fractured canals were to function. In any case, in crossing the natural drainage of the country, elaborate engineering would be needed to carry the canals over wadis and protect them against damage by flood water.

At least as serious are many other questions, such as whether there is sufficient water available, for the scheme envisages the diversion and storage of 2,200,000 million cubic metres of water, more than the total normal discharge of all the streams and rivers of Palestine. Sufficient storm water could hardly be stored to make up the difference. Storm water must be stored in winter for use in summer, and even if expensive waterproofing of the porous rocks were feasible, evaporation in storage and transit would be considerable. The irregularity of the rainfall would be a further complication in a country whose rainfall in a dry year may be 60 per cent. of that in an average year; and storage from year to year is even more expensive than from season to season.

In general it seems that the project, which has a strong political flavour, is over ambitious in proposing to use more water than is available. In order

[1] *Palestine Post*, March 1946.

to attempt a maximum extension of irrigation it introduces a series of expensive and difficult features. If somewhat less was attempted it could be done much more cheaply and simply, and the Government has a number of suitable projects in preparation or under consideration. It must be realized however that, while irrigation is the chief of a variety of ways in which the agricultural productivity of the country might be increased, the prospects are limited, and when the full facts of the present population position are taken into account it seems unlikely that the aggregate of any further improvements could more than meet the needs of the existing population and their children. In considering the much discussed "economic absorptive capacity" [1] of the country it is difficult to avoid the conclusion that agriculturally the country is already saturated.[2]

In spite of her unfavourable natural endowment, Palestine in the last quarter of a century has become increasingly industrial, so that even before the war industry was the dominant contributor to the National Income. This accomplishment has not been the result of the association of favourable factors which usually promote industrialization, for, apart from her position, Palestine has no natural geographical advantages and few home-produced raw materials, and the Mandate has made tariff protection impossible.

Of several factors favourable to industry, the first was the growth of the population, resulting in a demand for extensive constructional work and the production of consumers goods. The rapid growth of an increasingly prosperous population made it possible for the products of industry to be absorbed. Until the war, 75 per cent. of industry was concentrated on consumer goods and over 90 per cent. of production was for the home market.[3] Indeed, building constituted one-third of industry and at times of peak immigration employed as many as 43 per cent. of all Jewish workers (although it did not, and has not, reduced the severe overcrowding and high rents of houses).

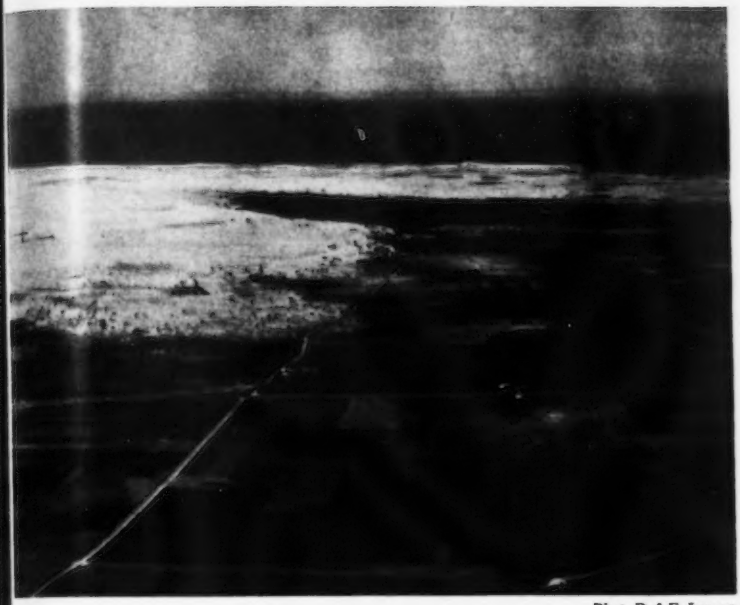
The second important factor was the great influx of skilled labour, enterprise, initiative, resource, and capital which has characterized Jewish immigration. Between the wars a trained and experienced industrial and commercial community was transplanted from Europe, often bringing with it modern industrial machinery, especially from Germany whose government discouraged the transfer of cash.

The introduction of industrial equipment in the years of world price breakdown in the early 1930's enabled new industries to be established at charges which permitted competition with older countries. The influx of new capital has been an enormous influence. Between 1922 and 1929 the Jews invested £80,000,000 in land, buildings, industry, and transport. The flow of funds from world Jewry to assist Jewish development in Palestine, averaging about £10,000,000 per year, has for some years offset the adverse balance of visible trade. Capital assets per head in Palestine have increased by over 230 per cent. in spite of the growth of population.

[1] Political economists might care to assess the consequences of uneconomic absorption of an increased population.

[2] M. G. Ionides, "The perspective of water development in Palestine and Transjordan," *J. R. Cent. Asian Soc.* 33 (1946) 271–80.

[3] Horowitz and Hinden, *op. cit.*, p. 92.



Phot. R.A.F. Levant

4. Southern coastal plain near Madjal with encroaching sand-dunes

Phot. R.A.F. Levant

5. The lower Jordan valley. Patches of intensive cultivation occur only where springs provide irrigation water

Phot. Jewish Age

6. Terraced slopes and bare limestone outcrops in the hills of Judah

Phot. Jewish Age

7. Typical Jewish settlement in the Valley of Jezreel growing citrus and oth irrigated crops

Thirdly, increasing power became available, first from hydro-electricity and later, and much more important, from oil. Crude oil was available in increasing quantity after 1935 and in the last few years refined oil has been produced. Fourthly, there has been a specialization on certain types of industry, such as those using materials of high value and small bulk and weight, which is important in both importing raw materials and exporting finished products. Polished diamonds, now the chief export, are the best example, and furs, false teeth, pharmaceutics, and fashion goods are others. Full use has also been made of local raw materials, such as textiles, olive oil for soap, and wines.

Finally, the war brought opportunities for a great expansion in many types of industry to satisfy the urgent demands of great armies perilously removed from their main bases of supply. Industry nearly trebled between 1939 and 1942 (Table IV). Textiles, metals, and chemicals especially showed great increases.

Table IV.—Numbers employed in chief groups of industries in 1939 *and* 1942 [1]

	Arabs		*Jews*		*Total*	
	1939	*1942*	*1939*	*1942*	*1939*	*1942*
Food and drink ..	1017	1841	3251	6908	4338	8749
Tobacco	614	842	383	474	997	1316
Edible oils	98	170	463	859	561	1029
Chemicals (including soap) ..	245	191	720	2220	965	2411
Wood and paper ..	330	879	1560	2435	1890	3314
Leather	66	213	94	973	169	1186
Textiles and clothing	835	3096	3038	8691	3873	11,787
Stone, cement, etc.	152	269	1072	2036	1224	2305
Metals	386	1137	2474	8107	2860	9244
Diamonds	—	—	197	3404	197	3404

An important question, naturally being asked, is to what extent Palestine's industries will survive when world trade has recovered and full competition has been re-established. There is no doubt that some industries are particularly vulnerable to overseas competition and may well decline. Much of the textile industry, especially the weaving branch, is one, based as it is on imported raw materials or yarns. Others are the manufacture of boots and shoes, of which the Arab side expanded eightfold, engineering and machine construction, which is entirely Jewish, and such industries as wire and electrical fittings and apparatus.

There are some less extensive industries which are partially protected by local habits of taste on the part of consumers, such as cigarettes and some shoes; while others chiefly using local raw materials, such as citrus jams and tanning, are only slightly vulnerable to foreign competition. The milling of local grain (which is largely in Arab hands, the Jews preferring the flour from softer imported wheat) is another of these. At least half of Palestine's

[1] Adapted from Censuses of Industry, 1940 and 1943. Government of Palestine, Department of Statistics, Special Bulletin No. 20.

industries are hardly affected by outside competition. These include prepared foodstuffs, mechanical workshops, tin products for citrus canning, printing, the various activities of the Potash concession, cement, and other industries associated with building.

Jews predominate in industry and are predominantly an industrial community (Fig. 13). They comprise 75–80 per cent. of all persons in industry, and twice as many Jews are engaged in manufacture as in agriculture. The Jewish industries show a higher output per head than comparable Arab enterprizes, and have superior capital and equipment—about 70 per cent. more

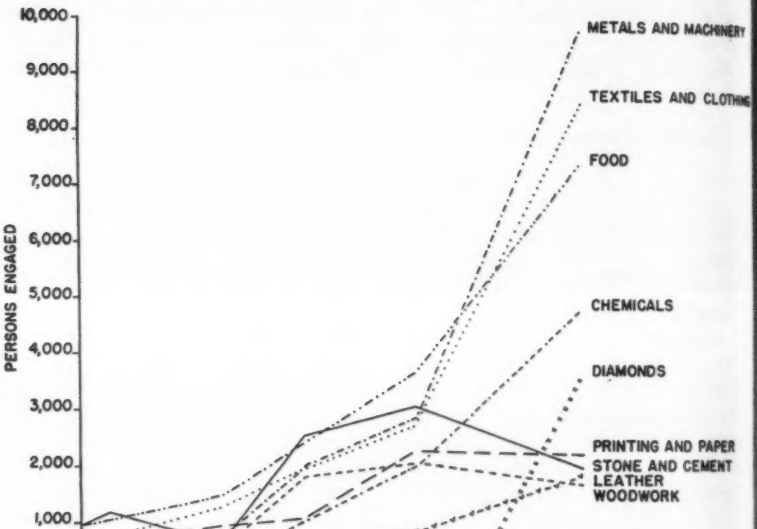


Fig. 13. Progress of Jewish industry, 1925–1943

capital per head. Jewish wages however are on average more than twice as high as Arab wages, and such comparable statistics as are available indicate that, in spite of their skill and capital, the productivity of labour power per unit of wages and salaries in Jewish industry is in general lower than in the corresponding Arab industry.

There is an extraordinary dichotomy in industrial production, as also in agriculture (except citriculture), the communities being clearly divided. The tendency for the undertakings of the two communities not to compete for the home market is a phenomenon which, paralleled in social spheres, is a factor of some political significance.

It is to foreign markets that Palestine's industry is now looking, but the future of much of her foreign trade is imponderable, except for such staples as

citrus, which formerly accounted for no less than 77 per cent. of her exports. The war created opportunities of increasing trade with other Middle East lands, although until the war the proportion of her trade with neighbouring lands was a diminishing one. The Middle East is Palestine's obvious market for manufactures, especially as consumer demands in these lands are likely to expand. With such expansion, there may be room for Palestine's products as well as those of the older industrial countries, but Palestine will need to temper zeal and energy with economic caution, for, to quote the report of the Anglo-American Committee, "It is conceivable that the passionate expansion of an economic structure, upon a dubious basis of natural resources, might lead to over-development on such a scale as to render it top-heavy to the point of collapse. The argument thus returns to the need for systematic improvement of the country's basic resources, for which . . . orderly progress in an atmosphere of peaceful collaboration is a *sine qua non*."

DISCUSSION

Before the paper the PRESIDENT (The Rt. Hon. LORD RENNELL OF RODD) said: The paper this afternoon is to be read by Dr. Willatts, who is too well known to Fellows of the Society to require any introduction. He accompanied the recent Anglo-American Committee to Palestine and is to speak to us on geographical conditions in Palestine, and particularly on human geography and agriculture.

Dr. Willatts then read the paper printed above, and a discussion followed

The PRESIDENT: Perhaps Mr. Bennett, formerly Director of Land Settlement in Palestine, will open the discussion.

Mr. M. C. BENNETT: I must at the outset say, as I am sure you will have realized from the paper, that much as we all try in Palestine to divorce ourselves from politics, the political question cannot be entirely ignored. So far as land problems are concerned, the politics of the country have been responsible for preventing the introduction of very desirable legislation and for introducing what can be called restrictive legislation in so far as the development of the country is concerned. Under legislation which I think should have been introduced to assist the development of the country might be mentioned the revision of the land law and an ordinance to control the use of water. These have been either shelved or openly objected to and not introduced. Under restrictive legislation one might mention the Cultivators Protection Ordinance which sounds very right and proper but has had the effect of restricting development; also the Land Transfers Regulations, 1940, which is one of the major items which the Jews in particular are trying to get repealed.

At the same time, those who have been in Palestine for a number of years—I spent twenty-five or more years there—feel that, in spite of the difficulties of policy, or lack of policy, and the disturbances which have taken place from time to time over the whole period of the occupation, something has been achieved. One might perhaps mention a complete change in the taxation system and the introduction of the Land Settlement Ordinance. I have no doubt in my own mind that the latter is one of the most important pieces of legislation that has been introduced in Palestine, but, like many other things, its progress has been impeded not only by politics but by the atmosphere created by politics. There is suspicion, particularly in Arab villages, that there is something behind all this urge for the settlement of titles to land; that it helps the Jews to acquire a larger area, and does not only assist towards the development of the country.

I was very interested to hear during the course of the paper that the classification of land made for taxation purposes had been used to provide statistical data, and I hope Mr. Dajani will later say something as to the reliability of the figures.

I do not think that I can usefully add anything further. I am sure we all feel the same about Palestine, and particularly those who have lived there for any length of time; we love the country and can only hope that it is not too late to find a satisfactory solution of its problems.

Mr. S. W. DAJANI (Senior Assistant Statistician to the Government of Palestine): The data used as raw materials for calculation were those of the land classification for the Rural Property Tax. The classification was applied in 1934. Mr. Bennett did a great deal towards introducing the classification and supervised its operation. The classification recognizes sixteen different classes or categories of land arranged according to their productivity. The land is taxed per dunum of each category. The tax amounts to approximately 10 per cent. of the average net annual value of each category. The "standard dunum" is a device which I employed in order to express land of different productivity in terms of the same unit. For this purpose a standard dunum has been defined as land belonging to category 12 of the Rural Property Tax Schedule. Areas under the other categories were related to standard dunums by being multiplied by conversion co-efficients. The co-efficients were obtained by dividing the tax rate of each category by the rate of tax for category 12. By this method the land in any zone or in the whole country can be expressed in standard dunums. The number of standard dunums in Palestine excluding Beersheba sub-district is over 14,000,000. It is interesting that the number of standard dunums in purely Arab rural areas is approximately ten times the population of each area. A study of a few villages showed that this was true in respect of each of them.

Mr. M. G. IONIDES (Secretary, Anglo-Arab Association, formerly Director of Development in Transjordan): There are two allied points in Dr. Willatts' lecture on which I should like to touch: rainfall and soil erosion. He seemed to me to suggest that the rainfall in Palestine is particularly variable and unreliable, by which I assume he means that it is unreliable compared with the rainfall in other countries with a similar climate. I went into this question in 1937 and 1938 and made a number of comparisons with countries in the Mediterranean and elsewhere with a similar climate ('The water resources of Transjordan and their development,' chap. III. Published for the Government of Transjordan by the Crown Agents for the Colonies, 1939). My conclusion was rather to the contrary, namely, that the rainfall in Palestine is somewhat more reliable than elsewhere. The facts do not seem to me to bear out the idea of exceptional unreliability and intensity from the point of view either of year to year variation of the average rainfall, or of the intensity of rainfall. In itself this is not a particularly important point, but it has a distinct bearing on the question of soil erosion; the idea of intense rainfall is coupled naturally with that of a serious soil erosion problem.

Soil erosion was also a matter into which we went in 1937 and 1938, and I belong perhaps to the minority in believing that erosion in Palestine and Transjordan, although "serious" is not actually "dangerous" as it is, say, in North America. It is the difference between accelerating erosion, in which soil is being rapidly washed away and the configuration of the ground changed, and a stable state in which loss is balanced by the formation of new soil. Any land after rain will bring down silt. The mere fact that silt comes down the wadis in Palestine does not necessarily indicate a dangerous state of erosion, demanding immediate preventive action. If you approach the problem on the assumption that

the soil erosion is of the accelerating kind, it is like sending for the fire engine when the fire is over. Soil erosion in Palestine is "serious" not so much because the land is in imminent danger of disappearing but because much of it has already disappeared.

It is difficult to get facts about this, but we did experiment in 1937 and 1938 in the whole of the Jordan basin upstream of Allenby Bridge (*op. cit.*, chap. VIII). We measured, by sampling, all the silt that came down the river for a year, gave generous margins, and came to the conclusion that the rate of loss of top soil over the whole of the Jordan basin was in the order of 0·06 of a millimetre per year; in other words, 1 inch in four hundred years. Judged by soil erosion elsewhere, that is very small. In America there are published records of up to one hundred times that rate. The rate of 1 inch in four hundred years is comparable with the geological formation. Stories of raging torrents carrying all the soil down to the sea provide bad quantitative evidence, and it is quantities that matter, not the colour of the streams.

The lecturer has referred to the Hays scheme, about which I know little more than has been published in broad outline. We are staggered by the sum it would cost: £50,000,000 I believe. It is so easy to assume that because it will cost such a lot it must be a big scheme, *i.e.* would make available a correspondingly vast amount of new water and serve a great new area of irrigated land. In point of fact it is a very small scheme, judged by schemes in other parts of the world, and fantastically expensive in relation to what it would achieve. For example, I made a scheme for a canal in Iraq before the war which was to dispose of about a quarter of the amount of water to be disposed of by the Lowdermilk scheme. The capital cost was under £6000 per cubic metre of water per second of canal capacity, compared with about three-quarters of a million under the Hays scheme; in other words, the Hays scheme is one hundred and fifty times as expensive. Naturally people are puzzled; they hear that there are many different kinds of possibilities of water development in Palestine—and so there are: wells, dams, store water, run-off, improved canal system, and so on—and they wonder how it can be said that there is not much scope for further development of the country in the sense of making new land available. It is like getting down to the bottom of a pot of jam—you have to scrape round to collect the last meagre spoonful. The mere fact that all these possibilities of development are being canvassed and are the subject of serious inquiry is in itself the most convincing evidence that development has reached its limit and that the country is agriculturally saturated. Even such a scheme as Hays' would not provide the land necessary even for the natural increase in the existing agricultural population. No one would dream of spending such vast sums as the Hays scheme involves for such a modest increase in irrigation water unless it was the very last resort to escape the penalties of an immigration policy which, as experts have consistently advised, the country's agricultural resource cannot sustain.

Mr. P. A. WILSON (Research Staff, Anglo-American Committee of Enquiry): I am neither a geographer not an expert on Palestine, but I have spent three months there studying the problem mainly from the economic angle. The speaker has referred to the economic future of Palestine, and for that reason I venture to call attention to an aspect which I have not seen discussed publicly. In its fifth recommendation the Anglo-American Committee, whose report I have here, recommended that the mandatory or trustee should proclaim the principle that the Arab educational and economic advancement in Palestine "is of equal importance with that of the Jews and should at once prepare measures designed to bridge the gap which now exists and raise the Arab standard of living

to that of the Jews." Since those words were written, Major Loftus, the Government Statistician, and his staff have given us figures which enable us to measure the existing gap in the standard of living between the two communities. The Jewish population of Palestine constitutes approximately one-third of the total population, and the non-Jewish population approximately two-thirds. Taking the recently published national income statistics as a measure of the standard of living, we find that the Jewish share in 1944 was not one-third but three-fifths of the whole—£*P*75,000,000 out of £*P*125,000,000—and the non-Jewish share only two-fifths.

Now if the standard of living of the non-Jewish community is in a short space of time to be raised to the level of that of the Jewish community that will be an undertaking of very great magnitude. It means that the £*P*50,000,000 income of the non-Jewish community will have to be raised to £*P*150,000,000 in order to bring its standard of living up to that of the Jewish community.

These figures are in Palestinian pounds. To arrive at their equivalent in sterling they ought to be divided by two. But that still means that the yearly income of the non-Jewish community in Palestine would have to be increased by about £25,000,000 sterling annually. To give you an idea of what those figures mean, I would remind you that Dr. Willatts mentioned a figure of £10,000,000 sterling as being approximately the magnitude of annual imports of Jewish capital, and that Mr. Ionides mentioned £50,000,000 sterling as the total capital cost of the Hays irrigation project. If you compare these figures with those I have quoted for the increase in the annual yearly income of the country which would be necessary if this particular recommendation were to be carried out, you will appreciate what a formidable undertaking it is.

Dr. A. E. Moodie: What appeals to me in Dr. Willatts' paper is not whether the Hays or the Lowdermilk schemes of irrigation are going to succeed or whether there will be more oranges this Christmas; those are undoubtedly important matters, but to me as a geographer the whole picture is the essential value of such a survey as we have had presented to us this evening. The geographical technique is important; also the cartographical representation of the essential data without which the planning schemes have no foundation and the political and economic problems have no satisfactory or acceptable solution. Those essential basic figures must be provided first.

I should like to make a point which is not strictly geographical but which has a geographical bearing. Great Britain has held a mandate in Palestine for some quarter of a century. In that time, and particularly during the last two or three years, all sorts of allegations have been made as to the so-called imperialism of Britain, in Palestine particularly. Dr. Willatts has given us the answer to that allegation this evening: the population trebled; a census taken for the first time in the history of the country, which is now looking forward to the third census; the productivity of the country increased to support that increased population which otherwise could not live, even making allowance for imported capital. In assessing what has been done under British mandate in Palestine it must be remembered that the efforts made, perhaps not always disinterestedly, have given rise to a specific contribution towards the welfare of both Arabs and Jews, and, to quote the final words of the lecturer, towards the "orderly progress in an atmosphere of peaceful collaboration," which is so essential to the future of Palestine.

Mr. W. G. East: I would like to take this opportunity of congratulating Dr. Willatts on the quality and interest of his paper. Here is a study in pure geography that takes full account of both the physical and the human aspects involved, gives a balanced survey, and is of considerable interest to those of us who

engage in teaching the various aspects of geography because it provides illustrative material for discussion of many of those aspects.

One may be interested in the historical geography of Palestine, about which one of the classics in the field of historical geography was written fifty years ago by George Adam Smith. Then it is instructive to note how this country is being transformed before our eyes and presenting an entirely different geography from that which one can reconstruct for successive periods. If one is interested on the other hand in economic geography, as so many are to-day, here is a country in which the problems are very much of that kind—so much so that one wonders whether it is not uneconomic geography which is presented. One has the curious thought that there is something going on rather like Mussolini's projects in Tripolitania, and one wonders whether it is going to succeed: whether Jewish capital, faith, and hope will be sufficient to hold in check possible uneconomic trends. Lastly, if one's interest is, as mine is, in so-called political geography, and that is a purely academic subject as we do it in universities, again Dr. Willatts' paper affords very useful matter, because the political geographer is concerned to look at the geographical background of the country or problems that confront us in various parts of the world. And here there is no necessity for me to point to the problems which arise, both internally and externally: they are only too patent.

With Dr. Willatts' help one can measure the country's small scale and its physical disunity; yet, at the same time, one is aware of the interrelated human and economic associations. That tempts one to make suggestions from the geographical angle in relation to the political problem that is so urgent in Palestine. The suggestion of partition, which has been one of several proposals, strikes the geographer as an unpromising and impracticable solution. The land is divided physically, as Dr. Willatts told us, but in its economic make-up it is inextricably interrelated. The idea of cutting it up into little bits, creating corridors and so on, and at the same time preserving this integrated economy which requires so much cooperative effort, seems fantastic. There would seem to be some case for the political association of Palestine with neighbouring regions because it is clear that we cannot think of that country and its problems in isolation. It is interested in the oil from outside, in water from outside, and in markets outside. The kind of thinking that envisages Palestine as part of a larger Middle-Eastern community is such that the geographer might deem worthy of special consideration.

Dr. E. C. WILLATTS: I am gratified to discover that the conclusions which I hesitated to stress in a paper which I tried to make objective have been generally correctly drawn. Mr. Ionides has had to leave us, so I will not join issue with him on the points he raised. Actually there is little difference between us. I spoke of the reliability of the rainfall in Palestine from the agricultural aspect. There are parts of the country in which, as I quoted and Mr. Ionides would not deny if he were here, "it is an actual experience that no harvest has been possible for four years in succession." That, I would say, is an example of unreliability of rainfall.

As regards erosion, I am glad to be assured by Mr. Ionides that things are not as bad as in North America where, in a few decades, large parts of the continent have been practically ruined. In Palestine agriculture has gone on for something in the order of four thousand years, and much of the land needs building up. What impresses one in the hills of Palestine is the need for more terraces, but that calls for more land settlement and more capital. I am still convinced that there has been a good deal of erosion, though I will not say here at what speed, so that over large areas of the country far more bare rock is exposed than soil.

There is already a good deal of land which is past recovery: it cannot be built up again because erosion has gone on for too long.

The PRESIDENT: Before closing the meeting I would like to emphasize two points. One is a point made by Mr. East on which it is especially appropriate for me as President of the Royal Geographical Society to touch. He mentioned the value of the contribution of the geographer to the study of problems such as the Palestinian problem, and I can think of many other subjects to which the contribution of the geographer could be of equal importance. I am happy to think that H.M. Government recognized this in appointing Dr. Willatts to the Research Staff of the Anglo-American Committee. I hope that will prove an example for the future when problems of this kind are being studied.

The second point was made not only by Dr. Willatts but by speakers who followed him, and is similar to a point made by Dr. Bertram during the last session of our meetings when discussing "Population trends and the world's resources." It is whether the rate of increase of productivity of any country can keep pace with the rate of increase of the population. In India we appear to have reached a point in which that presents virtually an insoluble problem. We have not enough experience to enable us to predict the ultimate course of events in Palestine, but the conclusions which can be drawn from the recent rate of increase of population do not seem to me to hold out much hope of the rate of productivity keeping pace with it. If that proves to be the case, then it will be a question of keeping the present population alive and not of adding to it by fresh immigration.

You will wish to thank Dr. Willatts for an extremely interesting paper, and also to thank those who have contributed to it by their subsequent comments.

Dr. R. O. WHYTE (Director, Imperial Bureau of Pastures and Forage Crops) *sends us a written contribution to the discussion*: Dr. Willatts' remarks on the Jewish dairy industry and the fact that this is based on a totally uneconomic production of fodder are correct. Costs worked out by Jewish economists at Rehovoth show that too high a proportion of the very high costs of producing milk is due to fodder costs. The land policy adopted by the Jewish authorities—very intensive land use and cropping system combined with fragmentation into small holdings in many cases—prevents the establishment on any scale of the cheaper source of fodder—irrigated pastures. Many problems of animal health, especially tick infestations, arise when irrigated pastures are managed according to present methods.

Free-range shepherding and nomadism are the two great problems of the hills and uncultivated areas. Nomadism is no longer a defensible practice in such a congested country and is the cause of frequent friction when the grazing flocks enter the more settled areas. The goats in the mixed free-ranging flocks are frequently blamed for ruining the vegetation and hence the land. The truth is that they have followed up previous and quite recent deforestation for timber, fuel, and charcoal burning, and prevent the regeneration of woody vegetation; they are the last factor to enter the destructive sequence but must be the first to go out.

A very serious drawback to the free-range system is that it robs the arable land of animal fertility, particularly stock nitrogen. This fertility is distributed all over the hills and wastelands where it is not required, while the starved arable fields can yield only one-third the cereal grain they might with proper management. Fodder production on the fallow should be extended wherever practicable to provide short-term grazing crops and fodder for conservation.

The evidence in winter-rainfall environments is not yet conclusive as regards the effect of vegetation on run-off, percolation, and the revival of springs

believed to exist in former times; it is a much debated point both in the Middle East and in California, where special experiments are in progress at the San Dimas Experiment Station.

The only hope for the hill lands of Palestine is that the ever-increasing pressure of human population will lead necessarily to increased terracing and tree culture, olives, figs, apricots, etc., and a great change in the Arab ideas and practices of animal husbandry. Grazing by hordes of low-grade low-producing animals must be replaced by many fewer but superior tethered and hand-fed animals producing the same total quantity of animal products. It would then become economic to spend money and labour producing fodder for them. The average milk yield of an Arab Awasi sheep is 30–150 litres per milking season. The top selected animal recorded by the Jewish Sheep Association produced 490 litres, on stall feeding.

AIR SURVEY: THE MODERN ASPECT

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Afternoon Meeting of the Society, 25 March 1946

PHOTOGRAMMETRY AS applied to survey covers a large field to which there are several lines of approach, depending mainly upon the requirements and the apparatus available. The application to large-scale mapping for engineering and cadastral purposes has its own problems, as has that for reconnaissance mapping at small scales, around 1/250,000, where some form of oblique photography is frequently employed. This paper is limited to mapping as affected by air photography at medium or tactical scales, between 1/25,000 and 1/100,000.

Surveying from air photographs has now become an integral part of topographical mapping, and no large programme will ever again be undertaken without employing it to some extent. If air survey is accepted as another tool for the surveyor and not as a means of survey, then it will be set in true perspective. The production of an accurate map from air photographs requires technical skill throughout all the stages from the flying to the printing of the map. Advances in photogrammetry have been dependent upon close liaison between surveyors, air navigators, photographers, radar specialists, meteorologists, and instrument designers.

The development of air survey and its implications

The first survey from air photographs, taken from a captive balloon, was made in France by Laussedat in 1858; but the first real application of air photographs to mapping was in the 1914–18 war, when military maps were made from air photographs taken from an approximately constant height and connected geometrically. At first the photographs were joined together to form mosaics, but because of the density of detail and inaccuracy of scale arising from distortions these did not compare with line maps. By taking strips

of photographs, with each photograph overlapping the next by some 60 per cent. to give full stereoscopic cover, maps of uniform scale were produced. Their accuracy was dependent upon that of the photography (as yet unreliable) and the amount of ground control. Progress was somewhat retarded after the 1914–18 war since surveyors, thorough and cautious by training, required full investigation before they would accept this new method. A noteworthy pioneer air survey was the 1924 survey for forestry purposes of the Irrawaddy delta, a swampy area where effective ground control survey was exceptionally difficult.

Meanwhile scientific investigation and development were taking place on the Continent, in the U.S.A., and elsewhere, while in this country development was in the hands of the Air Survey Committee, set up in 1921 by the War Office. The pioneer work carried out by Hotine as Research Officer to the Committee influenced greatly the trend of development of British methods. The British approach was to fly the photographs in such a manner that simple graphical methods for preparing the map could be used by ordinary surveyors. On the Continent, the tendency arising from the influence of instrument makers was to devise very elaborate and expensive stereoscopic measuring instruments with automatic plotting attachments. Operators of great skill and long training were needed to overcome the difficulties which arise when photographs are taken appreciably out of the vertical. In general the modern approach strikes a happy medium between these extremes.

Until quite recently, no method was available to determine accurately the position of an aircraft in space. Therefore maps could be scaled only when fully controlled by ground survey, and numerous heighted points were essential to accurate contouring. The recent successful experiments on employing radar to fix the air camera in space at the instant of taking a photograph have resulted in a change in the scientific approach to mapping which may prove as important as the first introduction of air survey. This experimental work has been in progress at the Directorate of Military Survey in very close cooperation with the Air Ministry and the Ministry of Aircraft Production during the last two and a half years. It has been established that topographical mapping from air photographs fixed by remote control from radar ground stations up to 250 miles away is practicable, and that it is possible to predict, within narrow limits, where each photograph will be taken.

The surveyor must always consider the economic aspect when making his programme, and this applies to all forms of survey. The survey pays few direct dividends, and consequently the advantages of intelligent survey planning are rarely obvious and in the past were seldom appreciated. It is now widely recognized that suitable air photo cover in the early stages of development of a country is of great value to all those interested in development—geologists, foresters, civil engineers, and others. The economical way of providing basic air photo cover is to fly it in the manner required by the surveyor, so that the main aim of the surveyor now is not to get air photographs taken but to ensure that the photographs are of the right kind.

This new approach to survey means that in general the work done on the ground is that of providing control for plotting from the air photographs, checking interpretation in doubtful cases, and identifying control points. In

some places, particularly where there are reliable native surveyors, ground survey will doubtless continue to be employed, although, if air photographs are required for active development in other directions, they should be taken in time to be of value to the surveyor. The result is that the surveyor now does most of his work in the office using the air photographs instead of on the ground with the plane-table. In topographical survey the geometrical basis of the plotting technique is in fact somewhat similar. For larger scales ordinary detailed ground survey is often indispensable.

The air photographs must be related to the ground in some way. Thus we cannot dispense with a triangulation survey as a basis, although the technique even of this is likely to change when radar methods of measuring long lines become sufficiently accurate. The amount of ground control needed depends upon the accuracy of the flying, the photographic processing, the survey methods employed, and of course the standard desired. For preparing the ground plan this control need be no more than fixed points identifiable on the photographs. For determining heights, since we have not yet succeeded in recording the altitude of an aircraft accurately, dense height control cannot be dispensed with, unless a form of photogrammetric "bridging" or air triangulation is used, as in the "Multiplex" system.

In time of war, air photography assumes paramount importance for mapping, since it becomes the only method of securing topographical data in inaccessible areas. This country owes a great debt of gratitude to the Photographic Reconnaissance organization of the R.A.F. for obtaining, often under very difficult and dangerous conditions, the raw material from which the R.E. Surveyors made not only maps for ground troops to use, but also flying maps and target maps for bombing.

It was found in the early months of the war that photographic reconnaissance needed a special operational outlook if the aircraft were to return safely to base. After a period of set-backs, high-flying Spitfire and Mosquito aircraft were used to provide the photographs needed by the map-makers. This was not ideal, of course, owing to the operational conditions, but it was adequate for tactical maps to be made when required. A very close liaison has always existed between the R.A.F. and R.E. Survey service, and it is usual to have a small liaison team of surveyors living and working with the R.A.F. This enables each to understand the other's problems and the best results to be attained.

Many hundreds of thousands of square miles of survey photography were jointly provided and shared by the British Empire and U.S. Air Forces. For example, with the assistance of the surveyors of the Royal Canadian Engineers and the U.S. Corps of Engineers, the R.E. Survey service in this country was able to make from air photographs some seven hundred entirely new maps of northern and western France at a scale of 1/25,000 in time for the Normandy landings. Similarly, the maps made from air photographs in the Western Desert contributed effectively to the victory at El Alamein.

Approximately half a million square miles of South-East Asia—Burma, Indo-China, Siam, Malaya, Sumatra—were covered by the R.A.F. and Fleet Air Arm for mapping purposes. The difficulties of accurate mapping due to lack of ground control in many of these areas were so great that the writer was

charged with the task of developing the application of radar to air survey in order that tactical maps could be made from air photographs fixed by remote control. Development and organization had advanced sufficiently by last autumn for a special combined R.A.F. and R.E. unit to be almost ready to be sent out on this work when the Japanese collapsed.

In case it should be inferred that one result of the war has been to map the world effectively, it is interesting to consider for a moment the extent of mapping in the world to-day. We find that the only extensive areas to have been mapped on scales of 1/25,000 or larger are in Europe, including the British Isles, Germany, the Low Countries, parts of France, and northern Italy, with a few small areas of special interest in other developed regions, notably in Japan and Indo-China. Areas which have been mapped on scales of 1/100,000 or larger are most of Europe, parts of the U.S.A. mainly in the east, most of India, and some parts of the Far East, including the whole of Japan. The rest of the world has been mapped only at smaller scales, and then seldom on a basis of regular surveys.

The necessity for accelerating mapping is now fully realized, and extensive programmes are in hand in the British Empire by the Ordnance Survey, the Colonial Office, and the Dominions.

The air survey problem

In order to see clearly how the modern methods of air survey have come about, let us touch briefly upon the principles involved. If we assume that the photography is perfect—*i.e.* that there are no distortions due to lens or photographic materials—then the photograph presents a true perspective picture. Thus, if an air photograph is taken truly vertically over completely level ground, the result is a true plan. It is not as simple as that however, and we are faced with two main difficulties: inclination of the axis of the camera from the vertical (or "tilt") and variations of ground height, both resulting in distortions of photographic images from their true positions. The basic geometrical relationship is illustrated in Fig. 1.

The effect of tilt is to present an oblique view and to cause variations of scale over the photograph. Even when the tilt is as small as 2°, there is a false difference of level of about 180 feet per mile; *i.e.* a gradient of 1 in 30, which is very significant when contouring is required. That height variation also gives rise to distortion of image can be seen in Figs. 2 and 3. This distortion is very important, and is clearly illustrated in Fig. 3 by the image of a hemispherical contoured hill obtained at the edge of a photograph; the contour lines become eccentic in plan and the central part tilted.

This combination of tilt and height distortion gives rise to the air surveyor's major problem in his use of simple methods, since the distortions due to height and tilt are radial from different points.

The radial line method is the simplest method of plotting. This is dependent upon the assumption that the principal point (or optical centre) of the photograph corresponds to a plane-table station and that angles drawn from it on the photograph are the same as those on the ground from the corresponding point. In Fig. 4 the photographs are represented by equivalent positives, and it will be noticed that the triangulation between the base-lines

$p_1 p_2$, $p_2 p_3$ and the two points *a* and *b* in the common overlap of the two photographs are linked angularly, but not lineally unless some control is available. This control is provided either by locating points on the ground

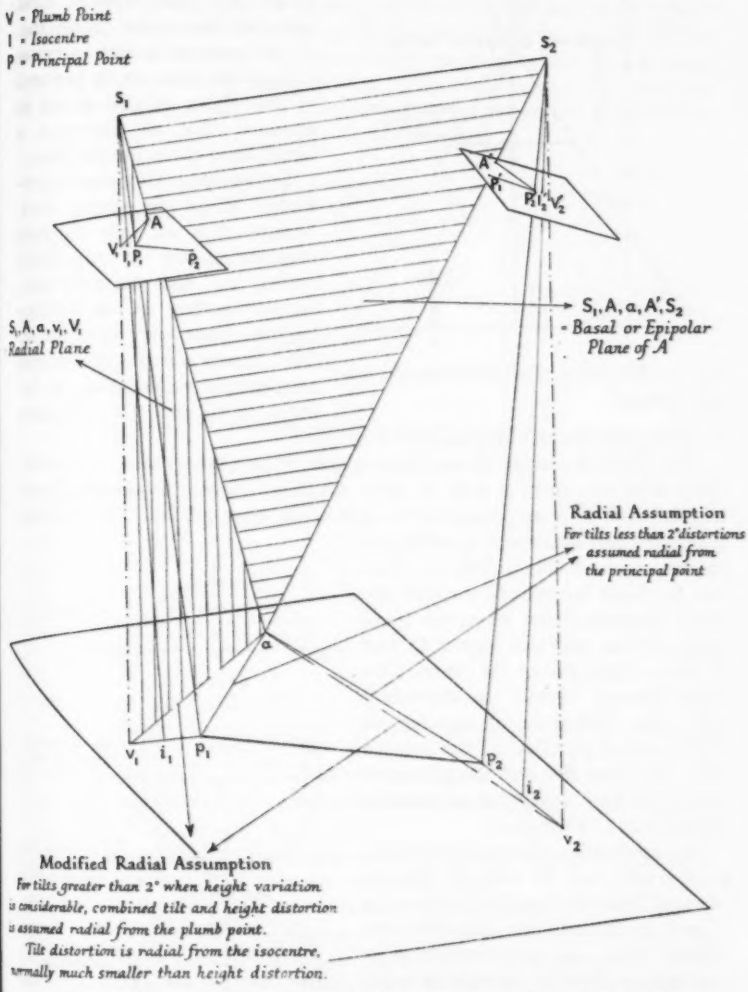


Fig. 1. Geometrical relationship of a stereo-pair of air photographs

which can be intersected on the photographs, or by knowing the positions of the camera stations by radar fixation.

When tilt is present, height distortions are radial from the plumb-point (Fig. 1), the point vertically below the camera, while distortions due to the tilt

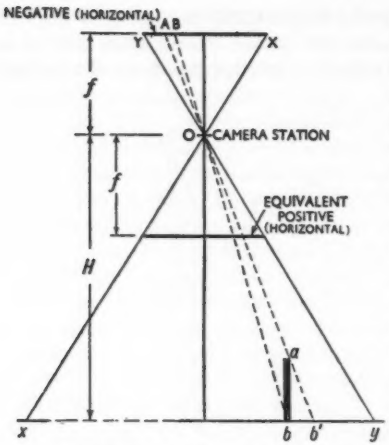


Fig. 2. Distortion of photo-image of vertical chimney

are radial from the iso-centre, a point almost midway between the principal point and the plumb-point. For topographical plans, provided tilts are not greater than 2° and ground height variations not greater than 10–15 per cent. of the flying height, it can be assumed that all distortion is radial from the principal point.

Stereoscopy.—Stereoscopy is essential to all air survey work, because it is not only the most accurate means of identifying points, but also the only satisfactory method of determining heights from air photographs. The faculty for really accurate stereoscopic measurement is not given to all and the attainment of consistent accuracy requires much practice.

The effect of placing an overlapping pair of air photographs in a stereoscope is to view them as with the eyes of a giant, whose eye-base may be up to 3 miles or more according to the scale of the photographs. The principle is perhaps best illustrated by looking at the two pairs of dots in Fig. 5. These can be fused by staring through the paper between them, when the fused image of one pair will appear to float in space above that of the other. This impression of "depth" is dependent upon the difference of spacing or "difference of parallax" of the pairs of dots, and from this and the geometrical constants of viewing, an assessment of height can be obtained.

The application of stereoscopy to air photographs can be seen in Fig. 6, where difference of parallax is shown in relation to difference of ground height. Before these can be assessed, it is necessary to know the spacing between the photographs, the focal length of the camera lens, and the approximate flying height. Differences of ground level can be determined directly only if there is no tilt; but this is unusual, and therefore either the tilt must be

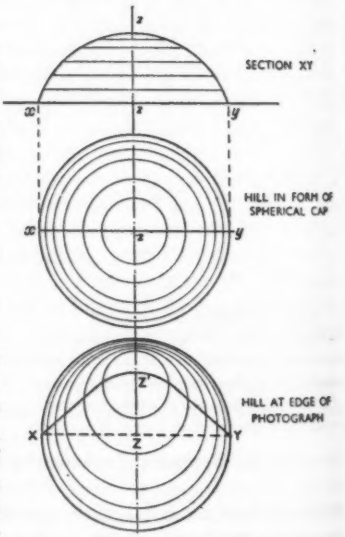


Fig. 3. Distortion of photo-image of hemispherical hill

found and correction applied or some means of adjustment must be employed to eliminate the error.

The spatial relationship of air photographs.—So far it has been assumed that the air photographs are taken in a plane parallel to the horizontal datum plane, or nearly so. This of course is very rarely the case. The first step is to set the photographs in their correct relative orientations in space and then to bring them into absolute orientation in relation to the datum plane. This has been the Continental approach, and it is now generally recognized that in some

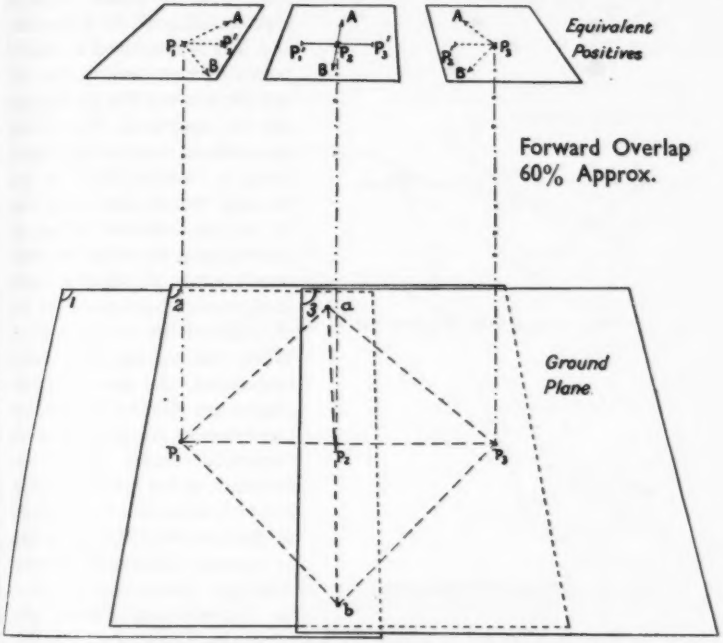


Fig. 4. Principle of radial intersection from air photographs

instances it is applicable to topographical and large-scale surveys, particularly for bridging height control between several overlaps.

Fig. 7 shows the basic relationship between the photographs and the datum plane, in which are contained the ground plumb-points v_1 and v_2 and the base of a vertical chimney at a. The photographs are tilted so that the photo plumb-points V_1 and V_2 are the radial centres, and the left and right radial planes pass through a and its photo images A_1 and A_2 on photos 1 and 2 respectively. It will be noticed that only if the tilts are small may the images of the top of the chimney b (B_1 and B_2) be assumed also to be in these radial planes.

Instruments in which the photographs are orientated in three dimensions do not however depend upon the radial plane principle, but upon the "basal" or "epipolar" plane principle, also illustrated in Fig. 7. The basal plane of

point a contains the air base S_1S_2, the point a, and its images A_1 and A_2; similarly the basal plane of b contains S_1, S_2, b, B_1, and B_2. From this it will be seen that, if each photograph of a pair is correctly orientated relative to the other, and the pair to the air base between them, the basal plane in which any point of detail and its corresponding photographic images occur is defined by a rotation about the air base S_1S_2.

If a pair of photographs set in a measuring stereoscope are tilted relatively, there is a relative displacement of corresponding images normal to the base line. This is called "want of correspondence" (or y-parallax), and if it is measured at selected points over an overlap, the relative tilt between the photographs can be computed. With a three dimensional stereoscopic instrument, a "setting drill" is gone through which eliminates want of correspondence before the photographs are relatively orientated; that is, all points are set in their correct basal planes so that the relative tilt can be read off. While maintaining the relative orientation, the pair of photographs can then be brought into their correct relationship to the horizontal datum plane, with reference either to ground control or to some other control such as that provided by radar fixes or accurate differential altimeter readings. Instruments such as the Stereoscopic Plotter produced by Barr and Stroud in conjunction with E. H. Thompson, the Wild Autograph A. 5, and the Zeiss Stereoplanigraph C. 5, all work on this principle, and have a plotting table attached. The Multiplex employs an anaglyphic projection device, but the principle of orientation is the same.

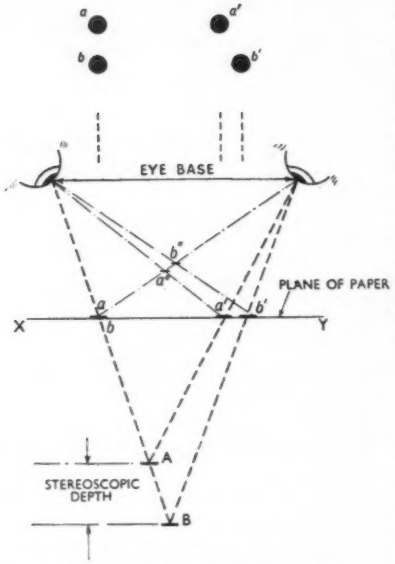


Fig. 5. Principle of stereoscopy

Air photography for survey

For some years it has been necessary to make do with the best photography possible under operational conditions. In the first years of the recent war, the only aircraft which could safely take photographs was the Spitfire, which did magnificent work but could not maintain the surveyor's basic requirements for line and level. Later the Mosquito was put into service and also did excellent work but was still not as steady as a survey aircraft should be. Moreover, the risk of interception necessitated flying high, and photography from an altitude of 30,000 feet with a 6-inch lens gave a scale of 1/60,000, which is too small for really accurate topographical interpretation.

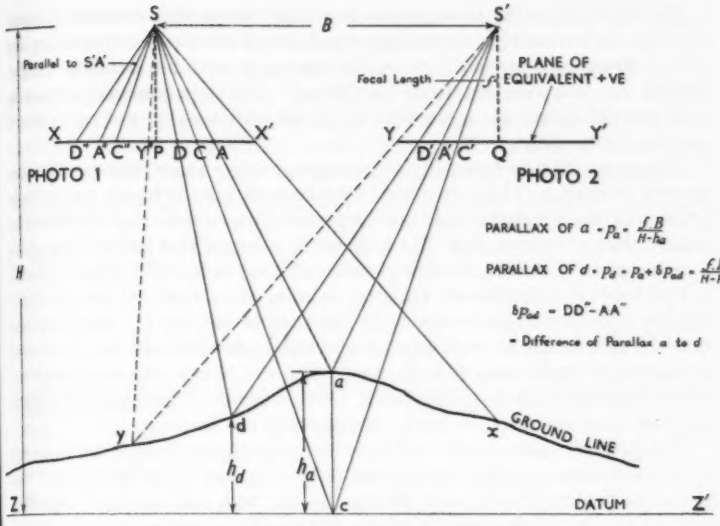


Fig. 6. Principle of stereoscopic parallax

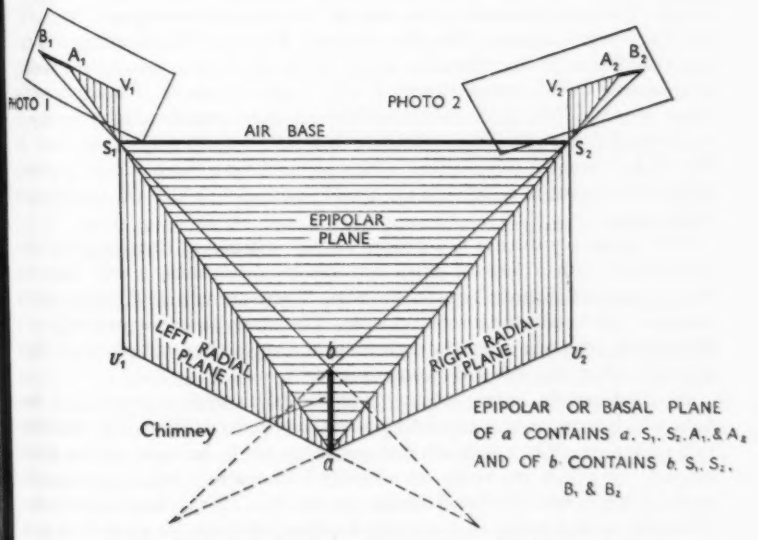


Fig. 7. Relationship of air photographs to the datum plane

The flying of survey photography in straight strips with constant forward overlaps for stereoscopic measurement and lateral overlaps for continuity is a skilled flying job, especially when the surveyor asks for constant height, limited tilt, and freedom from "crabbing." For topographical surveying with manual flying, not more than 2° of tilt with a 25–30 per cent. lateral overlap are specified.

The nearer to true verticality of photography, the easier becomes the surveyor's technique. Thus tilt control by automatic pilot is highly desirable in peace-time surveys, and should make it possible to guarantee that tilts are never greater than 1° or even less. Furthermore it is hoped that before long gyroscopic control of camera mountings will enable tilt to be still further reduced.

Problems of navigation are not great in areas where there are already fairly reliable 1/250,000 maps so that flight lines can be laid out for visual navigation. In areas where no such maps exist, considerable difficulty is experienced in starting to use the camera in the right place and in ensuring continuity and lateral overlap between photographs. Often a series of navigational control strips must be flown before survey photography can be begun.

This is where radar control will be of the greatest use. Quite apart from any special adaptation of radar navigational aids for survey, it has been found that the radar device Gee–H, used during the war with two remote controlling stations as a bombing navigational aid, will provide accuracy of navigation to 5 per cent. or so of lateral overlap when flying at 15,000 feet with a 6-inch lens. The aircraft carries a wireless set capable of interrogating each of the two ground stations and of receiving the return signal to ranges of 200–250 miles. By measuring the time taken for the signal to go and return, and knowing the speed of radio waves, the distances are computed. It is quite simple to decide on a range from one of the stations for a particular strip and then to fly in a circular track maintaining that reading. The small disadvantage of a circular track is more than balanced by the certainty of coverage and the facility of repeating a strip almost exactly if it is a failure because of weather or for other reasons. This will make possible not only considerable economy in photography, but also simple planning in areas where no maps exist at all. In Fig. 8, for example, some control strips planned for a block of survey photography are shown in relation to the actual positions in which the photographs were taken.

The air survey camera is a precise survey instrument capable of accurate calibration, with a lens of small but known distortions, a non-distorting shutter, and an accurate register for film. There are two new British survey cameras which fulfil these requirements. The camera must be properly set in the aircraft, on a non-vibrating mounting, and able to be levelled to the "flight allitude" of the aircraft and swung to its drift.

For best results, survey photographs are taken upon topographical base film, which must be very carefully processed to reduce differential distortions to a minimum. When accurate measurements are to be made on the photographs, the prints are made on sensitized aluminium foil, a photographic material which was developed during the late war. By this means, differential distortion at any point on a 9×9-inch photograph can be limited to about 0·01–0·02 millimetres, which is about the order of the most accurate stereo-

scopic "want of correspondence" measurement. For the three-dimensional instruments prints are usually made on glass.

The recording of instrumental data is important. In the new British survey cameras, most of the required records will be superimposed on the edge of the survey film; otherwise the necessary survey information is recorded by a secondary camera incorporated in an "automatic observer." When radar methods are used, the data for the fix must be recorded to allow measurement

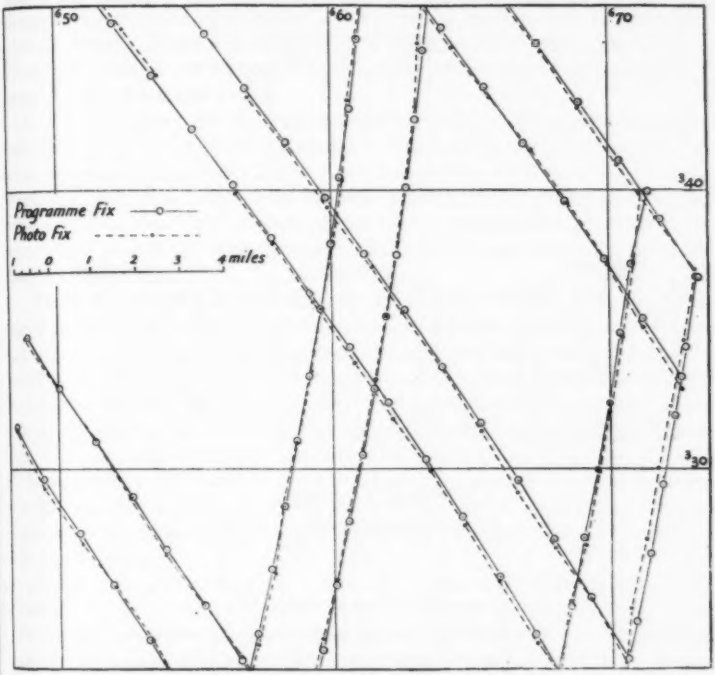


Fig. 8. Radar controlled air photography: planned positions and actual positions at which exposures were made

of the slope distances from the aircraft to the two ground stations at the moment of exposure of the photograph.

Accurate altimetry is very important for the surveyor, particularly differential values between exposures to establish the slope of the air base. In surveying from photographs fixed by radar, and given maximum accuracy of altimeter differences, it is possible to obtain relative ground heights without access to the ground at all. Temperature and air-speed recordings are required to correct altimeter readings.

Attempts have been made to record tilt from gyro-controlled artificial horizons, without much success as yet. However we still hope for success, and when we can be sure that tilts are less than $\frac{1}{2}^{\circ}$ and are recorded accurately to

0·1°, then another milestone will have been passed, and the surveyor will be able to simplify his plotting methods still further.

The approach to air survey

The radial-line method of control.—The pioneer application of the radial-line method of plotting in this country was the Arundel method developed by Brigadier Hotine, which was the standard topographical method of British surveyors until quite recently. In fact, so recently was it in use that a con-

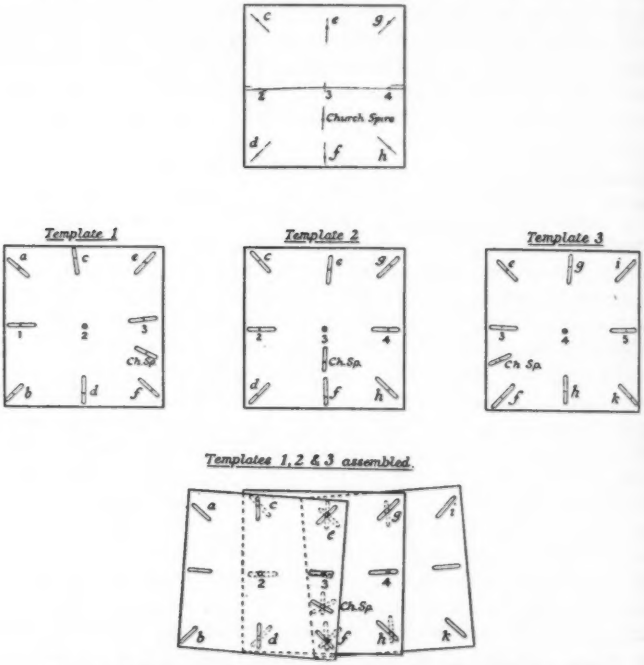


Fig. 9. Slotted template method of assembling air photographs

siderable part of the 1/25,000 air survey of western and northern France for "D" day was carried out by this means.

The radial-line triangulation method has since developed further and a mechanical device known as the "slotted template" not only makes the method simpler, but also saves time by enabling the triangulation to be plotted to scale without an intermediate stage. At the same time additional detail to scale can be provided as a "break-down" for compilation. Slotted templates are now the standard method, although there are one or two similar methods, such as the "radial arm" which closely resembles "Meccano."

Points of detail or "minor control points" are identified on each photograph in the strip, as *c d e f g h* on the middle photograph in Fig. 9. Of these, *e* and *f*

appear on both adjacent left-hand and right-hand photographs, while *c e g* are also on the adjacent upper strip and *d f h* are on the adjacent lower strip. 3 is the principal point of the photograph, and 2 and 4 of those adjacent.

Having identified all the points carefully in a stereoscope, fine radial lines are drawn on the photograph from the principal point through the minor control points, the principal points of adjacent photographs, and any control points such as the church spire. A transparent sheet or "template" is then placed over the photograph and the radial lines traced off accurately. The template is removed and a circular hole accurately punched with the principal point as centre. Then it is inserted in a machine which cuts slots about 2 inches long and of width equal to the diameter of the central hole, accurately centred along the radial lines.

All the templates are then assembled together on studs which have a diameter equal to the width of the slots. The stud at the principal point of each template is fixed, but all others are free to slide. Each stud has a hole in it through which a needle can be passed to fix the point in any desired position. Thus the block of photographs can be assembled to any scale of the same order as that of the photographs, the range of scale depending upon the length of the slots.

The scale of the plot is established by drawing up a master grid at approximately mean photo-scale, and plotting the ground control points on it. These are also identified on the photographs and slots cut in the templates, as for example at the church spire. The studs at such points are fastened in place by a needle and the slotted template assembled in respect of these points. If the points are accurately identified, the templates properly cut, and the photographs reasonably well flown, the templates will not buckle when assembled. If however they do buckle, a check must be made throughout, and failure to lie flat will then be due to a breakdown of the "radial assumption." Under ordinary circumstances this does not arise unless the ground height variations are considerable.

If instrumental recording of tilt could be relied on to $\frac{1}{2}°$ or so, it would be possible to use the method based on approximate plumb-points for much greater ground height variations than at present. When however it is necessary to determine tilts by stereoscopic measurement in order that plumb-points may be used to make the plan, the slotted method is not really satisfactory, although when modified by making rectified slotted templates from Multiplex projection it has proved very successful.

The slotted template method of compilation can be accelerated by selecting key points for compilation at the same time as the minor control points. Under the stereoscope the photographs are split up into small areas about $\frac{3}{4}$–1 inch across, within which the relative height distortion is insignificant. Rays are drawn through these points on the transparent templates. When these are assembled and set to scale, the rays will be seen to pass through a point. The scale positions of all these points in relation to the master grid can be established by drilling through the templates with a very small electric drill. The remainder of the compilation is straightforward, since detail inside the small triangles can be transferred direct, either by tracing if the scales are the same, or by proportional compasses or some other device for superimposing the

photo-image on the control. An example is the Trorey Anharmonic Rectifier (Plate 2). With this, the "break down" points are plotted on transparent material which is placed in reverse on the table. The corresponding air photograph is centred upon the photo-holder, which can be set for any tilt and scale adjustment, so that, on looking through a semi-transparent mirror, the photo detail to be plotted is exactly superimposed on the control points for that area. A special feature is the two-way tilt adjustment provided by a Bowden cable fitting. The slotted template method of plotting is about five times faster than the graphical radial line or Arundel method, and the amount of ground control is reduced to about 40 per cent. of that previously required to give comparable accuracy.

Height determination.—With the simple radial line method of plotting the plans for topographical mapping, simple methods of heighting from parallax may be used, provided a certain amount of ground control is available. Difference of ground height may be determined from a measurement of differences of parallax with a "parallax bar" (Plate 1), but unfortunately the apparent difference of level arising from "false parallax" due to tilt and air base inclination is often much greater than the actual difference of level. In effect, the datum of stereoscopic measurement is deformed, and these deformations depend upon the relative positions of the pair of photographs in space. When the photographs are set in a common plane in a simple stereoscope, the result of dissimilar tilts or of inclination of the air-base is that the stereoscopic impression of the ground is distorted. Unfortunately this distortion is rarely linear, since dissimilar tilts in the direction of flight transform the horizontal datum plane into a parabola, while dissimilar lateral tilts give rise to a hyperbola. Consequently we cannot apply a linear correction to eliminate tilt errors between measured differences of parallax.

If four heights are known in each overlap, simple "want of correspondence" measurements with a parallax bar enable the corrections for tilt deformation to be found and applied to the measured differences of parallax between points. Thus sufficient heighted points can be provided for simple stereoscopic interpolation of contours.

An alternative method, which enables these corrections to be arrived at almost mechanically, is the "floating plane" method on which some experimental work has been carried out at the War Office. A "mock up" apparatus employing a standard folding stereoscope and parallax bar is illustrated in Plate 1. Here a series of lines is drawn in pencil on the left-hand photograph, normal to the base line, while a transparent sheet connected to the parallax bar is placed over the other. On this transparent sheet are placed the same number of separate lines ruled on glass strips which can be adjusted independently, so that when the lines are fused stereoscopically they appear to be in a horizontal plane referred to the four control points. The irregular spacing and inclination of these lines results from the elimination of "false parallax" due to tilt. When the lines are set, adjustment of the parallax bar micrometer to bring the floating plane to ground level at any point gives the true difference of parallax, and hence the true difference of level, between the point in question and a control level. A special instrument for this purpose is now being designed.

Although a sufficient number of additional spot heights can thus be fixed in an overlap for accurate contouring at topographical scales, it is not possible to extend height control accurately to other overlaps. The floating plane method can however be used for "form lining," if the horizontal datum plane is established approximately by assessing the horizontal in the topography in successive overlaps; and although appreciable local errors are found, these are not cumulative along a strip.

The Cambridge stereo-comparator, designed by Thompson, is a precise measuring stereoscope, in which it is possible to measure want of correspondence to 0·01 millimetres, enabling the relative tilts of photographs to be determined by a modification of a method devised by Hotine with an accuracy of 1′-2′. A new grid stereoscope which will be cheaper and more portable is in production, and is expected to give similar accuracy. Given such values, it is possible to apply the tilt corrections to an overlap, and, by carrying relative tilts forward along a strip, to bridge over a gap in control for several overlaps. At present the labour of computation is considerable, but research work to simplify it is in hand, and is expected to enable this method to compete with Multiplex bridging for some purposes and to reduce the need for height control to a small fraction of that previously required.

Mapping on the basal-plane principle.—Several elaborate stereoscopic instruments have been designed to enable photographs to be set in their correct relative and absolute orientations. The essential principle in them all is that the photographs are first orientated relatively in relation to the air base and to each other so that want of correspondence is eliminated (*i.e.* the photo images of points appear in their correct basal planes) and, by a suitable system of projection or by viewing the spatial positions of the points, they appear in their correct relationship to the set scale.

The simplest instrument based on this principle is the Multiplex, which relies upon anaglyphic projection (Fig. 10). Small diapositives of the photographs are made on glass and set in adjustable projectors, fitted with either a red or a blue-green filter. When the projectors are so orientated that the photographs are set correctly relatively, and the air base so adjusted that the projection is horizontalized to scale, the superimposed red and blue-green images viewed through spectacles with lenses of complementary colours give a true stereoscopic impression. By moving a tracing table, which is adjustable for height over the horizontal table, a point of light, used as a floating mark, may be brought to the position of the projected point in the basal plane, plan position being recorded by a pencil immediately underneath the mark, and the height read off on a scale. The British version of this equipment, the Williamson-Ross is now coming into service.

By this means we are able to bridge heights over several overlaps and obtain accuracy comparable with having height control in each overlap. The density of height control required for Multiplex bridging varies with the conditions of the survey, but under reasonably good conditions and with skilled operators comparable accuracy should be obtained with about 10 per cent. of the density required by the simpler methods.

The Multiplex is often used for plan compilation as well as heighting, but for various reasons the slotted template method is generally preferable, leaving

to the Multiplex the task which it does best, of extending height control and providing control contours. In hilly country, however, the Multiplex is frequently used in conjunction with slotted templates. After approximate absolute orientation, slotted templates are cut to the rectified projections, thus enabling scale and azimuth to be held much more accurately than by the Multiplex alone.

The Multiplex was used extensively during the recent war, and many thousands of square miles were mapped with its aid in areas where ground control was limited. For instance, it was used in connection with the tactical

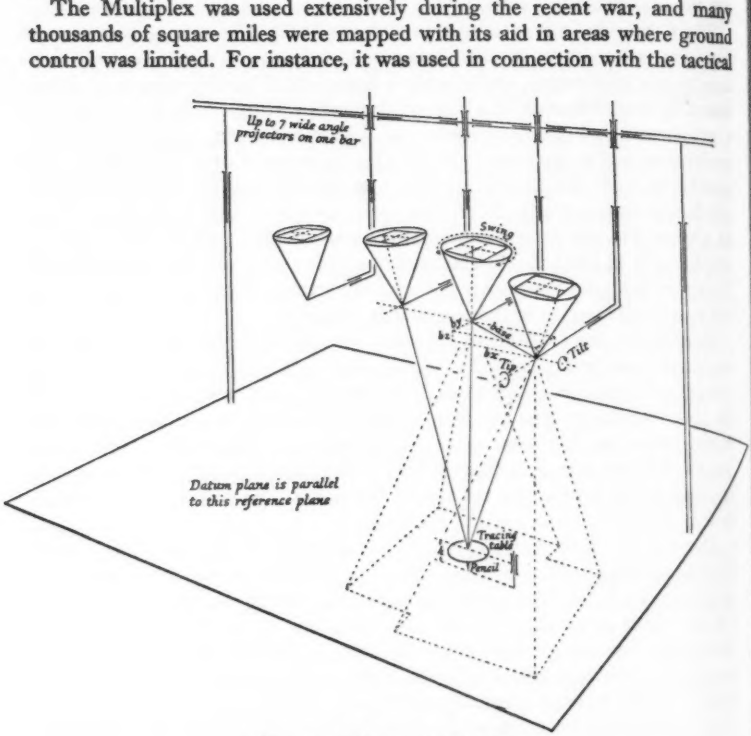


Fig. 10. Theory of Multiplex

mapping of southern France and Yugoslavia, the work being divided between the U.S.A. and the brigaded British and U.S. survey services in the Mediterranean. The Multiplex mapping project for the Rhône Valley advance was carried out successfully against time in the U.S.A. It was also used for special projects, such as large-scale contoured surveys of prospective landing fields for the airborne "D" day landings.

For certain purposes, particularly for amplifying limited control and for large-scale mapping, more elaborate and expensive instruments are employed. An example is the Swiss Wild Autograph A.5. This and all similar machines work either approximately or exactly to the principle of setting laid down by Fourcade in South Africa some forty years ago.

The effect of radar aid.[1]—Surveying from air photographs until recently has been complicated by inability to determine the position in space at which air photographs have been taken. This has necessitated an elaborate pattern of control points in order to apply correction to the photo images for unknown location, scale, and inclination of the photographs. It has now been found possible to reduce ground control very considerably for survey at topographical scales, and in some cases dispense with it altogether, by employing radar to fix the aircraft in space at the moment of exposing the air photograph.

During the last two-and-a-half years, a considerable amount of pioneer work has been undertaken in this country, and considerable success has been achieved, in mapping from radar-fixed air photographs combined with accurate calibration of cameras, careful photographic processing, accurate differential altimetry, and precise stereoscopic measurement. Radar and instrument records are made by a subsidiary camera which photographs an "automatic observer" and is synchronized with the survey camera. Even where it is not possible to gain access to the area to be mapped, the ground plan can be prepared with no control other than two accurately located radar stations which may be up to 200 or 250 miles outside the area. Although the result is not as accurate as when control is fixed directly on the ground, as it should be in any case in peace-time, range to the aircraft can be measured with an accuracy of $\pm$ 20 metres.

With the help of radar it is possible to pre-determine very closely not only the track for each strip, but also the position of each photograph along the strip (Fig. 8). This enables the photographs to be matched up laterally, and, given sufficient overlap for full stereoscopic investigation both along the strips and transversely, the surveyor can use normal traversing round a block of photographs. Moreover, for operational purposes, the fixes can be computed geodetically beforehand and simple interpolation used afterwards.

The matching of lateral overlaps gives one method of "setting down" to the ground (Fig. 11). If the altimeter differences are reliable, the "station plane" $S_1S_2S_3$ may be used as a basis for determining the datum. By stereoscopic measurement in a stereo-comparator and computation, or by setting in a three-dimensional instrument, the relative tilts between photographs 1 and 2, and 1 and 3, are found. The spatial coordinates of selected points on the ground are computed from their photo image positions in relation to the station plane, and then related to the earth's surface by transforming them through the angle of slope of the station plane. For preparing the plan the accuracy is that of the radar fix. Horizontal datum is established only approximately unless the absolute altitude of the aircraft is known or ground height control available. Relative ground heights however can be found with accuracy comparable with, but rather less than, altimetric differences between exposures.

At first this very elaborate procedure was repeated for every common overlap of a block, but the work involved made it quite impracticable, and various methods have been devised to reduce the amount of computation required.

[1] The application of radar to air survey was discussed in detail by the author in papers read at the Royal Society Empire Scientific Conference at Oxford in July 1946. These will shortly be published by the Royal Society in 'Royal Society Empire Scientific Conference Report, 1946.'

Without going into detail, it can be stated that provided a steady flying aircraft is employed, permitting accurate differential altimetry, it is possible to dispense with all ground control other than the remote radar stations and to

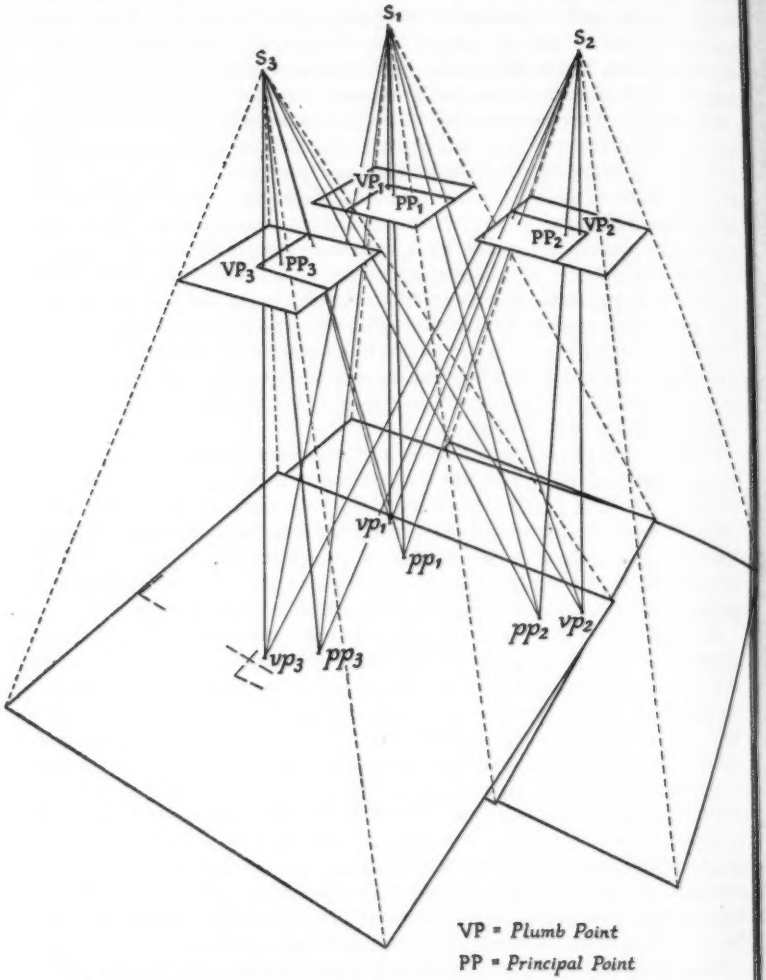
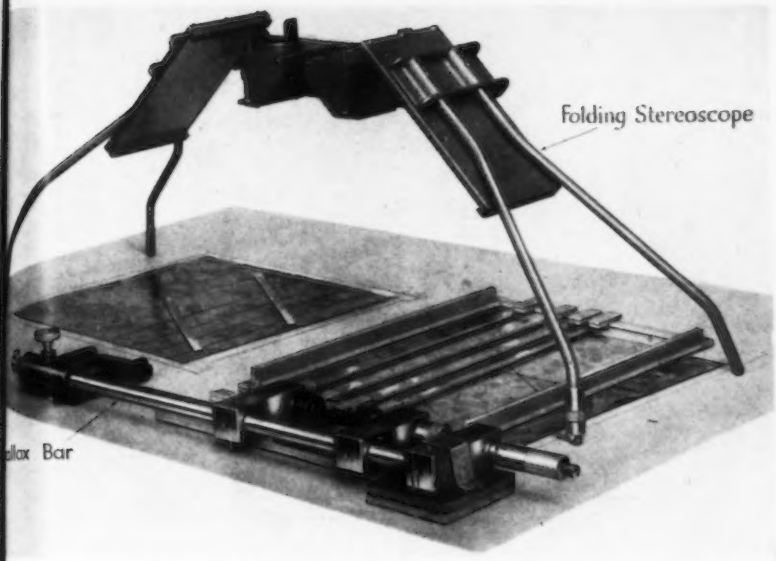


Fig. 11. Lateral and forward overlaps between three air photographs

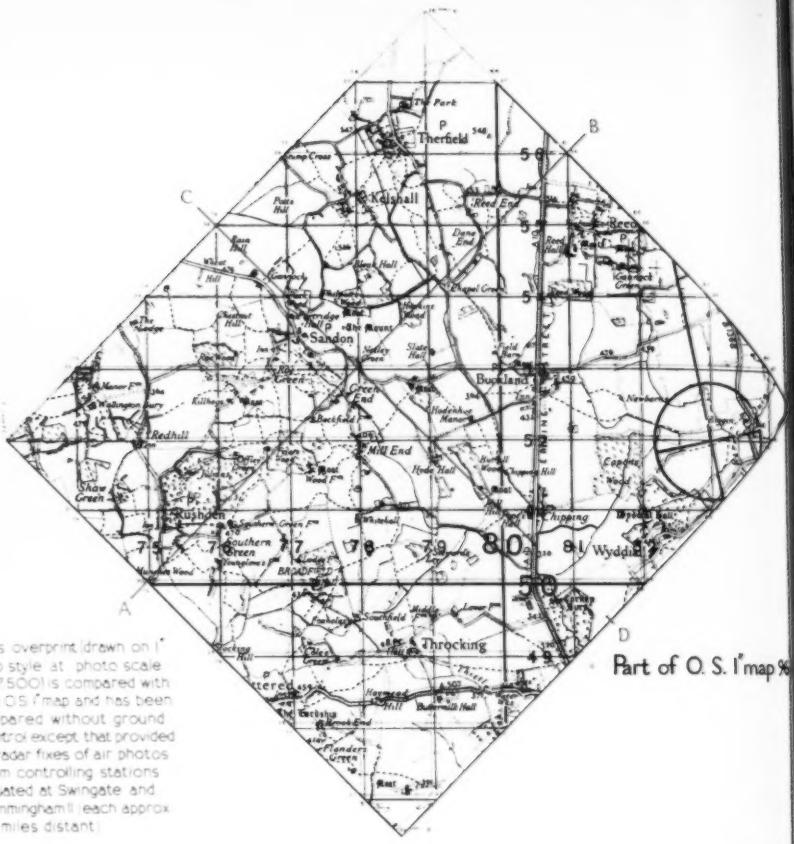
provide maps at a scale of 1 inch to 1 mile fully up to normal survey standards in both internal accuracy of plan and absolute location. Relative ground heights can also be determined to survey standard, but unless there is some accurate reference to mean sea level only an approximate datum can be fixed.



1. *Apparatus for simple height determination by the floating plane method*

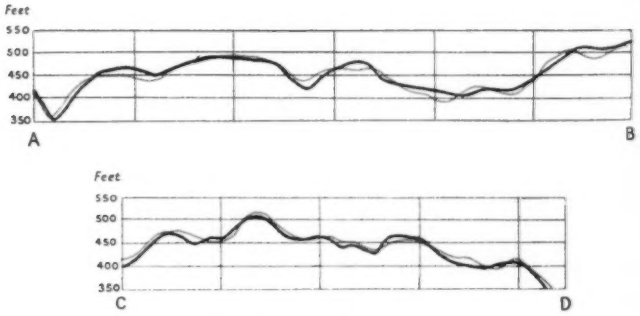
Phot. L. G. Trorey

Trorey Anharmonic Rectifier in use for plotting detail direct from air photographs



This overprint (drawn on 1" map style at photo scale 1/7500) is compared with the O.S. 1" map and has been prepared without ground control except that provided by radar fixes of air photos from controlling stations situated at Swingate and Trimmingham (each approx 85 miles distant)

Part of O. S. 1" map ¾



Comparative Sections

——— from O.S. 1" Map

_____ from Map prepared by Remote Control and Altimeter Differences

~~*Fig. 12. One-inch survey from air photographs overprinted in red on counterpart Ordnance Survey sheet, with comparative sections*~~

Fig. 12. Survey from air photograph overprinted in red on reduced 1-inch Ordnance Survey map of the same area, with comparative sections

By courtesy of the Ordnance Survey

For some requirements, particularly under operational conditions, 1/25,000 mapping can be carried out quite satisfactorily. Fig. 12 is an experimental map at a scale of 1 inch to 1 mile with no reference to the ground nearer than the radar ground stations 85 miles away. The experimental survey detail is shown in red, superimposed on the corresponding area of the Ordnance Survey map. Comparative sections with reference to a common datum are also shown.

The method of plotting at present advocated is to compute control points in groups at intervals of about seven overlaps, and prepare the plan by slotted templates, with bridging of height control by Multiplex. It appears in practice that for medium scale mapping in undeveloped country the density of ground control needed for the most effective use of radar is in the same order as for primary triangulation, that is, points about 30–50 miles apart, with a rather greater density for height control, possibly groups of points at intervals of about 10 miles.

DISCUSSION

Before the paper the CHAIRMAN (Brigadier Sir CLINTON LEWIS) said: Ladies and Gentlemen, Colonel Hart is Assistant Director of Military Surveys at the War Office. Prior to the war he was Senior Lecturer at University College, London, in Civil Engineering and Survey and carried out a great deal of pioneer work and instruction in air survey. This afternoon he is to describe air survey work and, in particular, to let us in on the secrets of radar as applied to the control of air photography. This development of radio science is one of which surveyors were quick to see the application to their own problems, and no one is better qualified than Colonel Hart to tell us about it. He has made it his special study since the inception of radar and, while Colonel Thompson and others of the Survey Service contributed a great deal in the initial stages, it is almost entirely due to Colonel Hart that research into the subject has enabled one of the major difficulties of air survey to be overcome—that is, fixing the position of the aeroplane in space at the instant of photography, and guiding it in the systematic covering of the ground.

Lieut.-Colonel Hart then read the paper printed above.

The CHAIRMAN: Speaking for myself, I have followed Colonel Hart's exposition with especial interest. I was engaged in air survey during the first world war and afterwards, and we used the very primitive methods of those days when not even radial line plotting had been developed. Whether or not you have been able to follow all the technical details described by Colonel Hart in his endeavour to condense such a wide subject into a single lecture, you will have realized what a great advance has taken place since those early days.

One cannot help feeling some regret at the passing of the plane-tabler, an artist in his own line who, in unsurveyed country like much of India and the Dominions and Colonies, covered every inch of the ground and got to know the country as few people do in these days of rapid transport. Still, he will not be entirely superseded, because the evolution of survey is rather like that of war. Although air survey has effected a revolution in survey methods, the humble foot-slogger is still an essential member of the survey team; he has to go in ultimately to clear up, to find out the names, to survey boundaries, and to locate the many things that are hidden from the eye of the camera, especially in jungle country. But although there is still scope for real plane-tabling in parts of the

Empire where native labour is cheap, its days are clearly numbered, as with many other arts which have been superseded by the machine.

Looking to the future, there is one other development of radar which may come about, and that is in the measurement of long arcs of the Earth's surface. The shape of the Earth is still not accurately known; it has been determined by triangulation of which even the most precise is subject to cumulative errors. It is possible that long distances, covered by a whole chain of triangulation, may eventually be measured more accurately by radar.

I ask you now to record our thanks to Colonel Hart and our appreciation of his most instructive paper.

THE DISTRIBUTION OF NATIVE POPULATION OVER SOUTH-EAST CENTRAL AFRICA

S. J. K. BAKER AND R. T. WHITE

THE AREA to which, for the purposes of this paper, the name South-East Central Africa has been given lies roughly between latitudes 6° and 22° south of the equator and is centrally placed on the high plateau-lands of Southern and Eastern Africa: the south-easterly element in its position relates only to the major region of Inter-tropical Africa within which its range of latitude includes it. It is situated between the plateaux of South Africa which lie to the south of the Limpopo and those of East Africa which are grouped around the shallow lacustrine basin of Victoria Nyanza. In so far as the area has distinctive geographical characteristics, they are mainly associated with its intermediate and transitional position between the more easily recognizable geographical regions of South Africa and East Africa. Indeed a case may be made for considering the area south of the Zambezi with the South African plateau-lands and Nyasaland and Northern Rhodesia with East Africa; and certainly the role which the Zambezi valley has so far played in the life of the territories lying within the drainage basin of the river has been that of a zone of demarcation rather than an artery of communication. It is thus better to consider South-East Central Africa as an area than to attempt to define it as a region.

The political units included in the area are the two Rhodesias and Nyasaland, Portuguese East Africa, with the exception of that part which lies south of lat. 22° S., the southern portion of Tanganyika Territory, and the Katanga Province of the Belgian Congo.[1]

The map of the distribution of native population (Fig. 3) overlaps that showing the distribution over East Africa in 1931, published in *Africa* in 1937,[2] and extends the area for which maps have been prepared southwards

[1] This province has since disappeared as a result of the reorganization of the administrative units of the Belgian Congo in 1933.

[2] S. J. K. Baker, "The distribution of native population over East Africa," *Africa*, 10 (1937) 37–54; map III, p. 43.

to the boundary of the Union of South Africa. To facilitate comparison, every attempt has been made to compile the new map on the same basis as its predecessor. In both cases the geographical scale of the original map is 1:2,000,000 and the demographic scale one dot for five thousand people. The figures for 1931 were not available for every territory of South-East Central Africa; in such cases statistics for the nearest available year have been used, varying between 1930 and 1934.

The limitations inherent in the statistics of population for this area arise

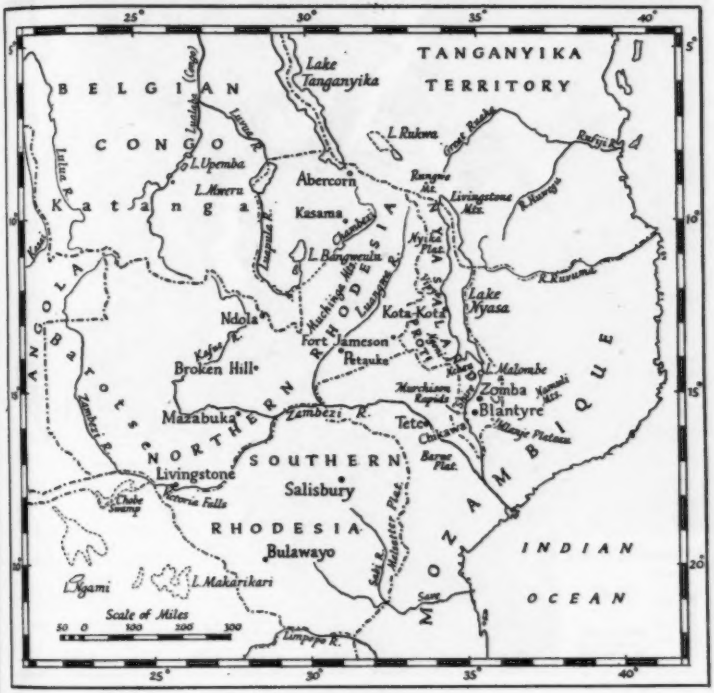


Figure 1

from the fact that they are in the nature of estimates, only Nyasaland having attempted a true census of the native population in 1931. On the map, the main limitations in representation are two-fold. First, except in the case of the Katanga Province, the District is the smallest unit for which population figures are available; and unfortunately this unit often covers a wide area within which the distribution is very uneven.[1] However, the dot method of

[1] The base map used in compiling the population map contained the District boundaries, and in addition in the case of the Katanga Province those of the Territoires, but for the sake of clarity these boundaries have been omitted from the finished map. The size of the District averages 5000 square miles in Southern Rhodesia and over 8000 in Northern Rhodesia where individual Districts exceed 20,000 square miles.

representation has permitted recognizable irregularities of distribution within the Districts to be shown. The second limitation is in regard to the unit of population represented by a single dot, a scale originally chosen in relation to the higher densities over the territories covered by the East African population map, and retained for comparison. While the scale of one dot to five thousand people makes it possible to give a general indication of the distributional pattern in the more densely peopled areas, there is perforce a diagrammatic quality in the distribution of dots within the boundaries of sparsely peopled

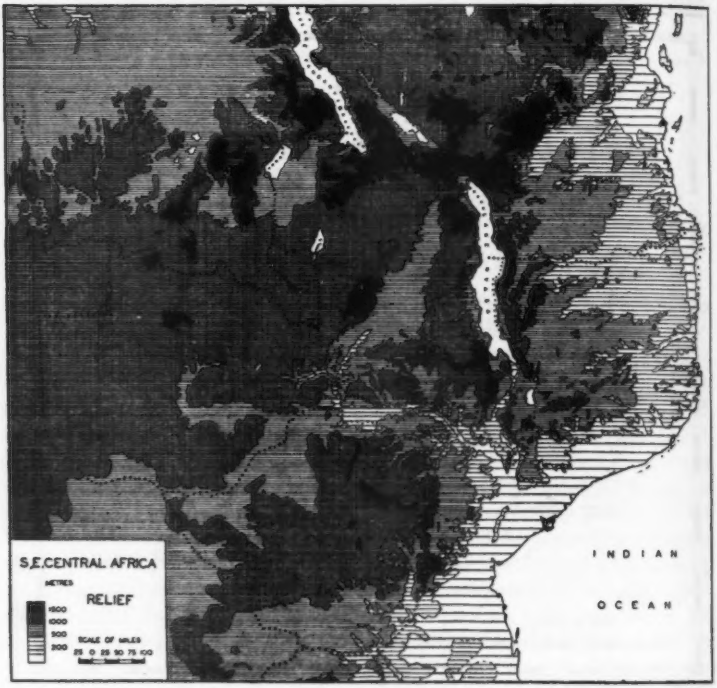


Figure 2

Districts. But even the position of these isolated dots generally has some significance, in that they have been placed where concentrations of population are most likely to occur. In compiling the map, every effort has been made to minimize the effects of both these limitations. Account has been taken, for example, of the African practice of concentrating near perennial supplies of water and of avoiding those areas which are blighted by the tsetse fly; and the fact that certain numbers live within the known areas of the native reserves has been used also. It is thus claimed that there is reasonable accuracy in the general distributional pattern, both within most of the Districts and over the area of South-East Central Africa as a whole.

The over-all density of population is undoubtedly low, even by the modest

standards associated with the African continent. With an area of approximately 1,746,000 square miles, South-East Central Africa supported in 1931 a total native population of about sixteen million, an average density of nine per square mile. This density compares unfavourably with the average of twelve per square mile for Africa as a whole, a figure which, curiously enough, is maintained both for Africa south of the Sahara and for intertropical Africa. The average is below that for the Union of South Africa and that for East Africa as understood in the paper published in 1937. Transvaal immediately

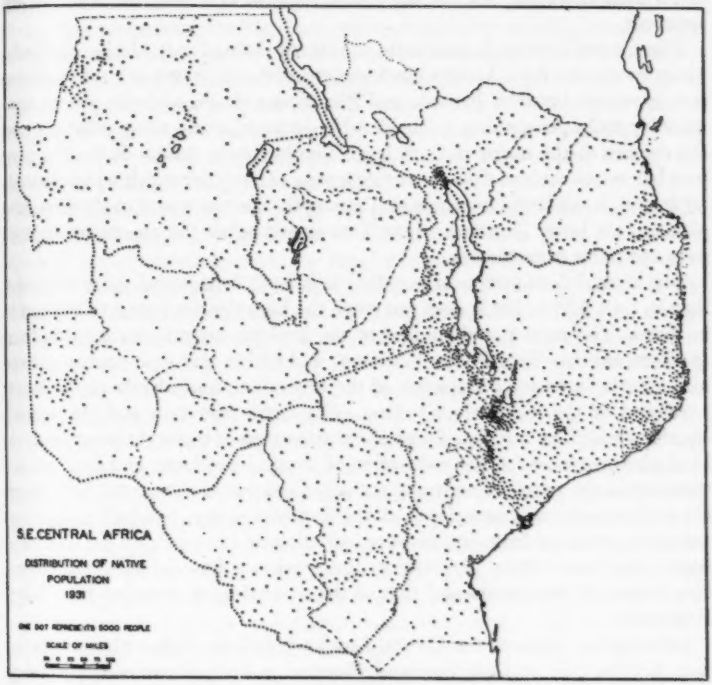


Figure 3

to the south has an average density of 15·5, and Tanganyika Territory on the north fourteen per square mile.

Within the area covered by the map, Nyasaland maintains the highest average with 40·5 per square mile.[1] It is followed by Portuguese East Africa with fourteen. The figure drops to seven for Southern Rhodesia and to five both for Northern Rhodesia and for the adjacent Katanga Province of the Belgian Congo. Within these various political units the distribution shows marked irregularities; and this is especially the case with the Nyasaland Protectorate.

[1] This had increased to 45 per square mile according to the 1940 estimates of population.

To study the distributional pattern of the population map, we must obviously break away from the territorial units and from the fantastically shaped frontiers which betray their unhappy genesis in the "scramble for Africa." In what follows an attempt will be made to describe the distribution of population against the background of the major physiographic units (Fig. 2) with which it shows some general correlations. The regional variations in the pattern of distribution are not so strong as those found over the East African territories. This may perhaps be associated with the more general uniformity of physical character, but certain broad, regional contrasts are none the less apparent.

The Coastal Lowlands constitute one clearly defined unit. Although fundamentally a part of the African block structure, the zone was subject to marine transgressions between Jurassic and Pleistocene times, with the young sedimentary rocks penetrating a considerable distance inland along what are now the courses of the major river valleys. The lowlands, which lie for the most part below 200 metres, thus constitute a zone of irregular width which extends far inland in the Rufiji lowlands of Tanganyika Territory and in the extensive plains of the lower Zambezi, where Tete stands below the 200-metre contour over 250 miles from the sea.

The coastal distribution of population is both denser and more extensive than in East Africa, but it does not reach the high density found to the south, in Natal. The most populous part of the lowland extends northwards from the Zambezi into Tanganyika Territory: and within this zone one can recognize a more intensive occupation of the immediate hinterlands of the larger ports and of the major river valleys. The fertile alluvium and the humid, equable conditions associated with the marine type of tropical climate provide ideal circumstances for the cultivation of tropical products, and facilities for transport to the ports are naturally at their maximum in the coastal belt. Along the well-watered northern slopes of the Zambezi valley, to which the natives are being attracted from less favoured districts as labourers on the extensive sugar, sisal, and cotton plantations, there exists a link between the coastal distribution of population and that of the more densely-peopled Rift Valley Highlands.

Intermediate between the Coastal Lowlands and the higher plateaux to the west lies the belt of Low Foreland Plateaux, a unit of distinctive physical character. It is represented in the Barue plateau to the south of the Zambezi, and is especially well developed to the north of the river in Portuguese East Africa and in the adjacent south-eastern part of Tanganyika Territory. Its absence is most marked in the plains of the lower Zambezi where the lowland penetrates westward into the interior. In general this zone of ill-watered landscapes slopes eastward from maximum heights of about 1000 metres, and a formidable scarp normally separates it from the high plateaux.

Since a perennial supply of water is of paramount importance to any human settlement, this sub-arid region can support only a sparse distribution of population; and in this it may be compared with the even more strongly individual Nyika belt of Kenya Colony. The only noteworthy concentration of population is located on the better-watered Namuli range, where modern plantation agriculture is being developed.

Immediately west of the Low Foreland Plateaux in the north lie the Rift Valley Highlands, characterized by the intense tectonic movements which formed them and by the variety and abruptness of their topography. The eastern and western branches of the East African rift system with their associated plateaux converge on the northern end of Lake Nyasa. There, significantly placed, the great volcanic mass of the Rungwe mountains was ejected in Tertiary times. The single Nyasan Rift Valley extends southwards as a well-marked trench for about 400 miles, to be continued by the Shire valley to the Zambezi. The plateaux to the east of Lake Nyasa, including the Livingstone mountains, are high but narrow, while their broader counterparts on the west extend as far as the down-faulted depression of the Luangwa River in Northern Rhodesia. The sharp-featured orography of this region causes it to receive the heaviest rainfall in the whole of South-East Central Africa, with annual totals exceeding 100 inches and some orographical rain throughout the year on the higher plateaux. Variety of relief and climate are reflected in a similar variety of vegetation.

Marked irregularity characterizes the population distribution in the Rift Valley Highlands; but regarded as a whole, with their good supplies of perennial water, they constitute by far the most densely peopled region in South-East Central Africa. The major concentration of the region, and therefore of the whole of South-East Central Africa, occurs in the highland area to the east of the lower Shire valley. Again the distribution is by no means even: the bulk of the inhabitants occupy land at an altitude of 750–1000 metres above sea-level, while the higher parts of the Mlanje plateau, for example, are entirely uninhabited. This concentration of population is in the main a natural response to the combination of a healthy climate and good soil and water conditions, but white settlement has exercised a certain influence. Blantyre and Zomba Districts together account for over half the total white population of the Protectorate of Nyasaland, and the density of native settlement, which rises in places to over five hundred per square mile, is to some extent caused by the presence of European towns and estates. In this area too, the natives have learnt from the Europeans to cultivate successfully such products as tea, tobacco, and cotton and thus to contribute to the export trade of the country. Large numbers of native immigrants from Portuguese East Africa have helped to swell the already large African population.

In the Shire valley below Chikawa the density locally exceeds three hundred per square mile. Apart from the presence of rich alluvium and a good water supply, early accessibility from the coast may be an important factor, for both road and railway tapped the agricultural resources of this area long before their stimulating effect was felt farther north. After a break in the distribution in the neighbourhood of the Murchison Rapids, where outcrops of bare rock, poor soils, and the loss of the river as a means of communication together exert their influence, settlement of a moderate density continues up the alluvial valley of the Shire, past the flats of Lake Malombe, to the southern shores of Lake Nyasa. The narrow coastal fringe of the lake is attractive for settlement, but nowhere does it present sufficient level land to support a really high density of population over any considerable area.

To the west an area of moderate density, exceeding one hundred per square

mile in the river valleys, stretches from western Ncheu northwards to the southern part of the Kota-Kota District across the plateaux of central Nyasaland. It has become the chief area for the native production of dark-fibred tobaccos. This zone of moderate density extends across the political boundary to the edges of the plateau overlooking the Luangwa depression, thus including the Fort Jameson and Petauke Districts of Northern Rhodesia.

Northwards from this central zone the distribution over Nyasaland is patchy, with large areas, including the high plateaux of Ngoni, Vypia, and Nyika, practically unoccupied. It is only at the northern end of the lake and beyond the boundary of Nyasaland that another nucleus becomes evident on the Rungwe plains and the adjacent slopes of the Rungwe highlands. The average density for the whole district is over one hundred per square mile; and this exceptionally high density is to be explained in terms of the rich soils derived from the alkaline lavas and volcanic ash of the Rungwe highlands. Here nature provided at least a partial solution to the problem of soil exhaustion which the native agriculturist has been unable to solve over much of inter-tropical Africa except by escaping from it under a system of migratory agriculture. In this remote area European economic enterprise would seem to have exerted no influence upon the pattern of population. Northwards from Rungwe the distribution thins out rapidly to the sparsity which characterizes the southern part of the interior plateau of Tanganyika Territory, with a slightly higher density over the high plateaux associated with the branches of the Rift Valley.

Separated from the Rift Valley Highlands by the deep, down-faulted valley of the Luangwa River, and from the plateau of Southern Rhodesia by the Zambezi trough, are the broad plateaux of the Congo–Zambezi watershed. We may call them the Congo–Zambezi Uplands. They present a steep escarpment to the south-east, especially well marked in the Muchinga mountains which rise immediately to the west of the Luangwa depression. Behind the escarpment, uniformly high plateaux ranging from 1000 to 1500 metres in altitude contain the shallow basins occupied by Lake Bangweulu, the upper Kafue, and the upper Zambezi above the Victoria Falls. North of latitude 10° S. this somewhat monotonous landscape is succeeded by a zone in which faulted basins, including those of Mweru and Upemba, alternate with intervening horsts, before the more uniform conditions of relief which characterize the upland basin of the Congo are reached in the north-west at an altitude of 500–1000 metres. In the south-west the high plains of Barotseland, comprising the basin of the upper Zambezi, merge almost imperceptibly into the Ngami basin, and the ancient crystalline rocks dip westward below an increasingly thick covering of Kalahari Sands of recent date.

The region of the Congo–Zambezi Uplands as a whole is very sparsely populated, never exceeding four per square mile in the open higher-plateau country. Perhaps this is as high a density as the thin infertile soils will support under the citemene system of agriculture, whereby the ground is fertilized prior to cultivation by wood ash obtained from burning the branches and brushwood of pollarded trees. It is a very wasteful method of land utilization: in the Abercorn area, for example, $6\frac{1}{2}$ acres of trees are needed to fertilize $1\frac{1}{4}$ acres of cultivated ground, and the proportion reaches 10 to 1 in some

districts. This fertilization is sufficient for four or five years' cropping, after which the village is moved, usually to within 5–10 miles of its former site. The trees are not fit for re-cutting for another twenty to thirty years. Thus under the existing system of cultivation the agricultural tribes of the poorer-soiled areas present of necessity a very scattered distribution. It should be remembered however that the ravages of the Arab slave trade may be a contributory cause of the sparsity of population over the plateaux of Northern Rhodesia; while at the present day five-eighths of the whole area is invaded by the tsetse fly.[1]

Population is thus sparsest on the high plateaux of the main watershed and in a latitudinal zone immediately to the south. North of the watershed, both in the Katanga and in north-eastern Rhodesia, the general density becomes slightly higher, probably as a result of concentrations where particularly favourable conditions prevail. There is, for example, a marked local increase in density, not apparent in detail on the map, around Lakes Mweru and Bangweulu and in the Luapula and Chambezi valleys where perennial fishing supplements the normal vegetable food supply of the natives; over eighty per square mile is recorded on some of the islands of Lake Bangweulu. In the adjacent part of the Katanga, concentrations occur in some of the well-defined valleys of the zone of varied relief already referred to. These depressions provide both a source of water-supply and an easy terrain for communications: thus we find well-marked lines of settlement in the Lualaba valley as it emerges from the northern end of the Upemba trough and, farther west, along the course of the Lulua River. Already, too, the railways are beginning to exercise their attraction to the native settler. Finally, a decidedly higher density prevails throughout the north-western territories. These lie within the zone of early socio-political development which characterized the southern margin of the Congo Basin in pre-European times.

In the high plains of Barotseland large areas of interfluvial plateau without water and covered by barren Kalahari Sands remain uninhabited. Population is restricted to the vital river valleys. The area has remained free from tsetse fly and is therefore open to cattle; so we find that the land on the river banks, subject to annual flooding and manured by the cattle, is rendered highly fertile. The concentration of population on the map within the Barotse Province is at least partly due to a steady inflow from across the Angolan frontier since 1917. Numbering about one hundred thousand, these immigrants account for roughly a third of the present population of the Province.

Traversing Northern Rhodesia from Livingstone to Broken Hill and Ndola is the mining railway which continues northwards into the Katanga. In its Northern Rhodesian section a 60-mile-wide belt along the railway has been alienated to Europeans; but on both sides there stretch areas of native farms as near as may be to the railway line. This would seem to explain the slightly higher density which occurs in the District of Mazabuka. On the whole however, up to the date for which the map was compiled the presence of Europeans in Northern Rhodesia does not seem seriously to have altered the

[1] 'Rhodesia–Nyasaland Royal Commission Report,' map 3. Cmd. 5949. London, H.M.S.O., 1939.

distribution of native population. In 1931 the total number of native workers employed in Northern Rhodesia in all the various forms of European service did not exceed eighty thousand, which represents an insignificant proportion of the total population. The social consequences of wage labour however are of the utmost importance.

The Plateau of Southern Rhodesia has a central ridge, everywhere above 1200 metres, which runs from the vicinity of Bulawayo north-eastward to the neighbourhood of Salisbury and slopes gently on either side to the valleys of the Zambezi and the Limpopo. The north-eastern part of the plateau, where the maximum elevation is attained, shows certain characteristics reminiscent of the Rift Valley Highlands, with the down-faulted valley of the upper Sabi running from north to south and the narrow, faulted Melsetter plateau separating it from the Low Plateau Foreland of Portuguese East Africa.

The demographic position contrasts with that found in any other of the physiographic regions of South-East Central Africa in that a moderately dense population, relatively evenly distributed, covers most of the plateau. Various factors are possibly contributory. The presence of intrusive granites over much of the plateau constitutes a favourable factor relating to water supplies, although as everywhere the need for water tends to limit the local distribution to the river valleys and better-watered slopes. The absence of the tsetse permits the keeping of cattle, which tends to the maintenance of soil fertility. Native reserves, although in area sadly inadequate for their populations, have a widespread distribution, occurring in every District except Bulawayo. They comprise about 30 per cent. of the area of the Colony and they contained in 1931 roughly two-thirds of the native population. Most of the remaining one-third either lived as squatters, labourers, or domestic workers on land alienated to Europeans or remained in precarious tenure on unassigned land; only 1 per cent. of the permanently settled native population lived on mines or in the towns. The conclusion is that at that time European influences had affected the general distribution of native population, but to less extent than might have been expected. Thus, while the distribution is widespread over the whole plateau, the main concentration extends over its better-watered south-eastern half, tending to be grouped in native reserves lying below the highest areas, which have been alienated to Europeans, and above the drier and less attractive lowlands of the Limpopo valley and the south-eastern plains.

The last regional landscape to be considered is that of the Riverine Depressions of the interior. This includes the middle Zambezi Valley from the Victoria Falls to the Kafue confluence, the Luangwa valley of Northern Rhodesia which continues its south-west to north-east alignment, and the west-to-east flowing section of the middle Zambezi valley from the Kafue confluence downstream to the coastal lowlands. The hot and arid landscapes of this three-legged system of broad depressions are comparable with the Limpopo valley between the plateau of Southern Rhodesia and the Transvaal. Unlike the relatively narrow tectonic groove which occurs within the Rift Valley Highlands and has a largely lacustrine character, these broader valleys, also of tectonic origin, form zones of separation between the major plateau lands. W. M. Macmillan's description of the Zambezi Valley at Tete, a little

farther downstream, as "fiercely hot, an almost arid waste of thorny shrub" [1] is everywhere applicable within the Riverine Depressions of the interior.

All these depressions appear on the population map as areas of very sparse distribution and help in a negative way to define the limits of demographically better-favoured regions. They naturally constitute a markedly unfavourable environment and comprise areas of refuge in which certain primitive food-gathering groups eke out a meagre existence.

When we attempt to assess the significance of the distribution of population and the extent to which it represents an adjustment to local environment, it becomes evident that many factors have been at work—singly, in conjunction, or in opposition—to produce the pattern of distribution as we see it to-day.

Of all the factors, that of perennial water supply is without doubt the most important throughout South-East Central Africa. In so far as this supply is absent over wide areas and varies in amount and reliability in others, so is it faithfully reflected in the very uneven distribution of population. The map clearly shows the general increase in density over the more favoured parts of the Coastal Lowland, on the windward side of the Plateau of Southern Rhodesia, and within the well-watered Rift Valley Highlands; but only a very detailed map would reveal the way in which the population is in fact crowded around the local sources of water. There are reports from both the Rhodesias and from Nyasaland describing the dangerous degree of concentration in the well-watered localities; for with such overcrowding are associated soil exhaustion, the removal of the vegetation cover, and ultimately the complete erosion of the soil. Before 1939 the respective Governments were paying a good deal of attention to improvement in water supplies, especially by the boring of wells. The scientific development of irrigation should provide the basis for a much more even distribution of population and, providing soil fertility can be maintained, should enable the land to support a great increase in density over the area as a whole.

Naturally, fertile soils will support a denser population than less favoured ones, as is shown by the high degree of concentration over the Rungwe plains; but there are indications that under the traditional economy practised by the native agriculturist the soil factor has not yet exerted its full weight. In applying the citemene system of wood-ash cultivation the natives have used good and bad soils alike. Soil fertility has begun to exert its full discriminatory influence on the distribution of population only where permanent agriculture of the modern type has been developed, as in south Nyasaland.

Apart from primitive agricultural practices, various other factors have combined to help in limiting the population. They include the incidence of disease, malnutrition, and starvation; the practice of anti-social customs, such as abortion and infanticide; inter-tribal warfare, sometimes accompanied by migrations, as with the Zulu conquests of the nineteenth century; and the operations of the Arab and other slave raiders, which were particularly effective over the Congo–Zambezi Uplands and the Rift Valley Highlands. There is indeed every indication that the state of affairs in South-East Central Africa prior to the arrival of the Europeans was far from static; and many changes

[1] W. M. Macmillan, 'Africa emergent,' p. 34. London, 1938.

must have led up to the conditions of unstable equilibrium depicted in the map of the distribution of native population in 1931.

In modern times, some of these factors have ceased to operate and others have taken their place. Apart from the distribution of the tsetse fly, which has a very obvious influence on the pattern of population in Northern Rhodesia, the factors associated more specifically with the present day tend to be human rather than environmental and to spring from European intervention in the life of the area. Native reserves, for example, have been established in both the Rhodesias. So far the distribution of native population has been much less affected by the setting up of reserves than has been the case in the Union of South Africa; but if at any time the policy of segregation, upon which the system of reserves is based, were to be more rigidly enforced the natural pattern of distribution would be correspondingly affected.[1]

Modern economic considerations have already begun to exercise their influence and are likely to play a large part in future adjustments of the pattern of population distribution. An example has already been given of the way in which natives have begun to settle near the railway zone in Northern Rhodesia, where their produce finds easy transport to a ready market in the copper-mining belt. High rates of transport discourage, or even preclude, commercial agriculture in villages remote from the European settlements: for example, the transport rate from Kasama in Northern Rhodesia to the nearest point on the railway at Broken Hill is $3\frac{3}{4}d$ per lb.

Up to 1931 the mining and industrial areas had not perceptibly affected the general features of the population pattern; but, in so far as all manual work is carried out by the native population, they are likely in course of time to cause demographic adjustments, even if they remain on no more than their present scale. Certainly this will be the case if an attempt is made to replace the present temporary and casual labour by a supply of permanently settled labourers living near their place of work, as in the Katanga portion of the copper belt. As it is, mining and industrial enterprize is mainly responsible for the large-scale temporary labour migration, which has such far-reaching economic and social results in the contemporary life of South-East Central Africa.

The phenomenon of labour migration arises fundamentally from the fact that while the European enterprizes which require labour are concentrated in very few localities, the native population is distributed over a vast area and such concentrations as occur are usually not coincident with the areas of mining and industrial activity. Nyasaland has a relatively large native population and practically no industrial development. Northern Rhodesia with a very sparse native population has developed, mainly since 1931, a small copper-mining area of tremendous importance on the borders of the Katanga. In Southern Rhodesia the presence of a considerable, well-established European population and the demands of mining and agriculture have resulted in an acute shortage of labour, and European employers have for many years been dependent on the import of labour from surrounding territories. In 1937, of the entire native industrial population of Southern Rhodesia only 40 per cent.

[1] Nyasaland, with approximately nine-tenths of its area scheduled as Native Trust Land, provides in this respect a contrast with the Rhodesias. See 'Rhodesia–Nyasaland Royal Commission Report,' map 5. Cmd. 5949. London, H.M.S.O., 1939.

were indigenous, and of a total of ninety thousand five hundred natives employed in the mines only twenty-three thousand eight hundred were indigenous. In the same year there were sixty-four thousand labourers from Nyasaland and twenty-nine thousand from Northern Rhodesia employed as temporary workers in Southern Rhodesia. At the other end of this long labour supply-line there are native villages in Northern Rhodesia and Nyasaland where over 50 per cent. of the adult male population is normally absent; and in 1930, for example, there were reports of local famine in Northern Rhodesia resulting from the shortage of men to clear the fields for planting.

Of the future it is more than usually difficult to write. The population is undoubtedly far below its optimum level. There would be need for a greater rural population to operate the agrarian revolution implied in the introduction of scientific methods of irrigation, manuring, and crop rotation; and there is certainly demand for increased manpower in connection with the industrial revolution which has come to certain areas. In the absence of vital statistics, and with the knowledge that although some hindrances to the growth of population have been banished others have come to take their place, it would not be wise to forecast whether the native societies will respond to this demographic opportunity. Nor is it easy, for territories where major considerations of economic and social policy are still likely to be the subject of political controversy, to go beyond the tentative suggestions of future adjustments of the relative distribution within the area already put forward. One can be certain however that the processes of change which have operated on so considerable a scale in the past will continue in the future to effect modifications, perhaps of a fundamental nature, in the pattern of population distribution as it existed in 1931.

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THE PORTAL PEAKS OF RUWENZORI

P. H. HICKS

AFTER THE work of such an eminent explorer as the Duke of Abruzzi, followed by Dr. Humphreys' wide and detailed researches, nothing on a large scale remains to be discovered in Ruwenzori, and no outstanding peak remains to be climbed. There are nevertheless abundant small topographical features to be brought to light, and during 1945 R. M. Bere and I were attracted to the area of the Portal peaks and the north-east slopes of Mount Gessi. This area contains the source of the Lamia river, which is an important feature of Ruwenzori; there also appears to be some discrepancy, reported by Dr. A. J. Haddow in the course of his travels in Ruwenzori, in the position of the Portal peaks as at present known. Both these points presented an attractive problem.

In 1906, when the Duke of Abruzzi with his party of scientists and alpine guides left Naples for East Africa, the journey from Italy to the base camp at Bujongolo in Ruwenzori occupied fifty-four days, and to reach this base a caravan of four hundred persons left Entebbe in Uganda on 15 May 1906.[1] Soldiers, porters, servants, and hangers-on marched in this train half a mile long, to cover on foot 180 miles through the swamps and bush to Fort Portal. Local chiefs were fêted along the route, and this journey itself was worthy of note at the time. At last, on 7 June, the party reached their base after a twenty-three day march on foot from Entebbe. In 1945 Bere and I left Kampala at half-past four on a cloudy afternoon and, by driving through in the early moonlight, reached our hotel at Fort Portal by eleven o'clock that night. By correspondence, we had arranged in advance for porters to be ready

[1] Filippo de Filippi, 'Ruwenzori. An account of the expedition of H.R.H. Prince Luigi Amedeo of Savoy, Duke of Abruzzi.' London, 1908.

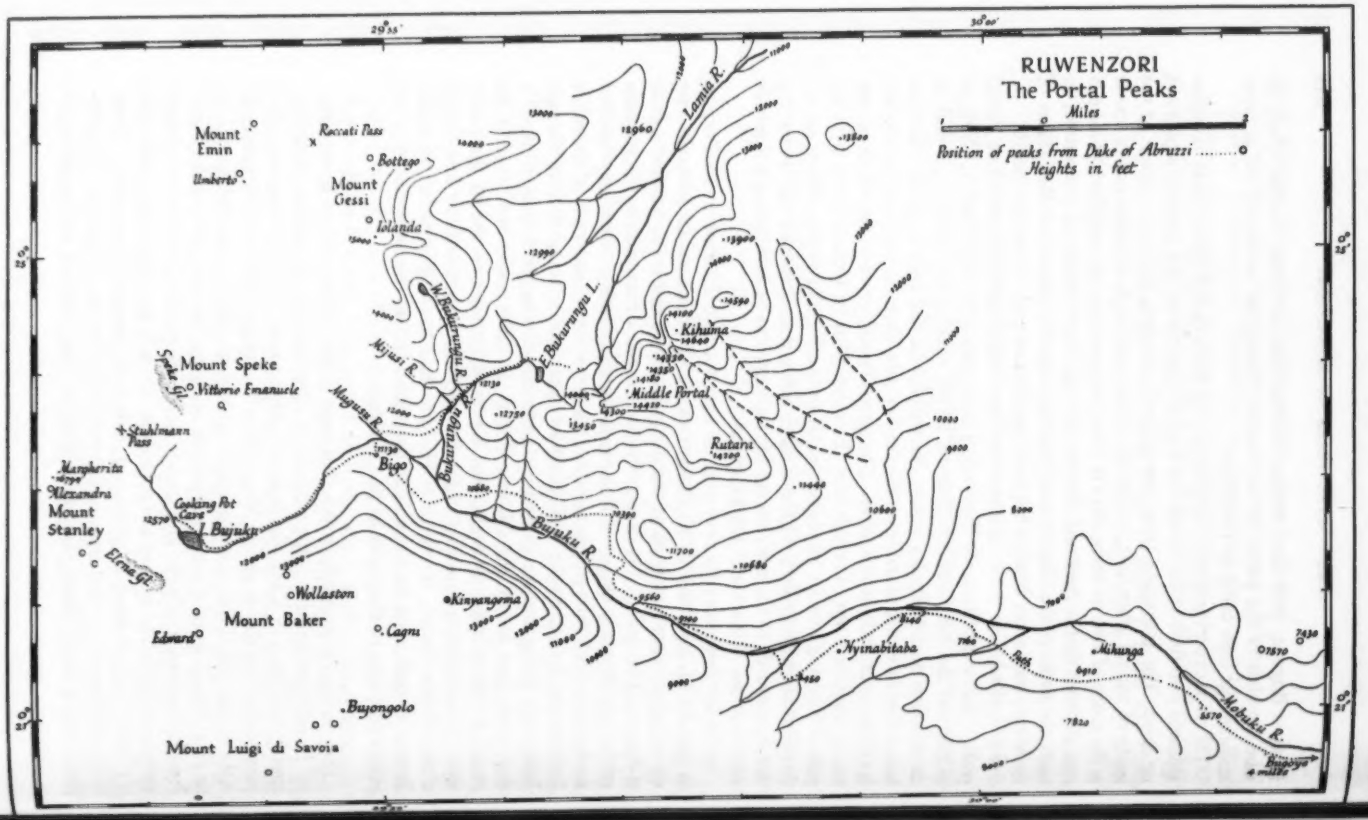
for us at Bugoye, with their rations of dried fish and flour, so that when the third member of the party, R. G. Ladkin, joined us we started off at once, reaching our base camp in three days.

The train of servants and hangers-on, the soldiers and fêted chiefs have disappeared into limbo; the chiefs are now civil servants, the journey a pleasant car drive. The transition from low tropical swamps, hazy with steam or the smoke of annual grass fires, to the thin cold air of high altitudes can be made in the space of two or three days if your preparations are well laid. There is even rumour that a road will be cut through the foothills of Ruwenzori to reach the snow peaks. Ruwenzori, the inaccessible, rain-filled Mountains of the Moon, may soon boast a hygienic sanatorium and picture postcards.

It is curious how little comment has been made on the outstanding Portal peaks. Most expeditions to Ruwenzori have passed by their foot, yet little or no mention has been made of Rutara, a very striking and steep rock peak at the entrance to the Bujuku valley. Viewed across the deep gorge of the river from a thin terminal moraine on the farther side, Rutara rises nearly 6000 feet in a distance of little over 2 miles. The name Portal, given to the whole mountain, is singularly apt. From below, the solid pillar of Rutara forms with the peak of Kinyangoma an imposing portal to the Bujuku valley. From above, the mountain with its long northern ridge forms a complete curtain across the view downwards to the east, except for a glimpse to be had through a narrow valley between Rutara and Kinyangoma.

In the last few years two expeditions have focused interest on the Portals. In 1942 R. M. Bere and R. N. Posnett ascended the mountain from the east side along the northern bank of the Mobuku river, and made the first ascent of Rutara. The going was extremely bad in the dense and wet vegetation growing on the steep slopes of Rutara, and unfortunately, when they reached the summit, thick mist prevented them from getting a clear view of the other Portal peaks. In early 1945 A. J. Haddow climbed the west side from the east Bukurungu valley and, crossing the divide into the upper Lamia, climbed a steep gully just below the Middle Portal. In mist and rainy weather he ascended a steep rock pinnacle, which proved later to be one of the many small pinnacles on the summit of the Portal Ridge, and made the first ascent of the Middle Portal. It was after Haddow had had a glimpse of the main Ruwenzori peaks that he was able to draw attention to the discrepancy in the plotted positions of the peaks he had climbed.

Early in 1945 it seemed possible that leave might allow a visit to Ruwenzori, and I made preliminary plans with R. M. Bere and R. G. Ladkin, both fortunately stationed in Kampala, to spend three weeks on a climbing trip. Our plans centred on the ascent of Mount Stanley (16,794 feet), the highest peak in the range, and if that was successful other peaks were to be attempted. At the same time I worked out a scheme for mapping the area around the Portal Peaks in the time available, and started negotiations for the necessary survey instruments which were then at a premium. I finally got temporary possession of a battery of four aneroid barometers, two good prismatic compasses, a hand level, a pedometer, a steel tape, and several other items. The outfit was completed with a locally made plane-table fitted for carrying in a canvas pack, and


RUWENZORI
The Portal Peaks
Miles
Position of peaks from Duke of Abruzzi .....
Heights in feet
Mount Emin
Umberto
Raccati Pass
Bottego
Mount Gessi
Iolanda
Lamia R.
W. Bukurungu R.
E. Bukurungu L.
Kihuma
Middle Portal
Mount Speke
Vittorio Emanuele
Stuhlmann Pass
Margherita
Alexandra
Mount Stanley
Cooking Pot Cave
L. Bujuku
Elena Gl.
Bigo
Mubuku R.
Bujuku R.
Rutaru
Wollaston
Kinyangoma
Mount Baker
Edward
Cagni
Nyinabitaba
Mihunga
Mubuku R.
Buyongolo
Mount Luigi di Savoia

a large golf umbrella of gaudy design. This proved to be the king-pin which held the survey work together, as experience of wet weather in these mountains was soon to show. Instruments such as a theodolite and a mercury barometer were out of the question due to the war shortage, but it was hoped that any deficiencies in the instruments used could be rectified while in Ruwenzori by constant checks against the substantial number of points available.

The essential framework of the map of the central peaks of Ruwenzori had been very efficiently completed by the Italian expedition in 1906, and the detail filled in by the observations and maps made by Dr. Humphreys on his numerous expeditions. Between the high altitudes, already well delineated, and the forest boundary at the 7000-feet contour, which represents the upper limit of commercial interest at present, there lies a no-man's land ranging from 15 to 30 miles in width and containing peaks of 12,000 feet and over which have never been climbed and whose position on the map is generally vague. It is in this belt that the wettest conditions and the densest vegetation occur, and mapping and photography and even simple movement can be very seriously hampered. De Filippi speaks with feeling on this point. He says,[1] "The path is all water and mud. You sink in to the knee. Under the mud the foot meets with stones or pieces of wood, or is caught in a creeper or a fallen trunk, making it necessary to grasp the surrounding bushes, frequently thorny, so as not to lose balance. Little by little you learn to take precautions in walking, to recognize the points likely to afford solid foothold. . . . But, even so, you frequently become entangled or get stuck, and seek solace in expletives which are more energetic and expressive than elegant."

Since we planned to travel very lightly, loads were carefully calculated, and on Thursday 24 May the party assembled at Bugoye, which is a small chief's headquarters at the lower end of the Mobuku valley. The following day we set off with twenty-seven porters, of whom seventeen were paid off after three days. These men came from the Bakonjo tribe, who live on the eastern slopes of the mountain and have gained a reputation for cheerfulness and skill at load-carrying in the mountains. The men we selected presented an extraordinary range of features, from a good-looking, almost Egyptian type to a prognathous half-pigmy. Their lives and thoughts appeared simple in the extreme. They dress themselves in a scanty loin-cloth with perhaps a small skin garment around the body. Though they are keen and successful hunters of the hyrax, for which they ascend the mountain up to 12,000 feet and over, they appear to have no wish to clothe themselves with more in spite of the cold at higher altitudes. With this clothing and the cotton blanket and sweater which is part of the contract of their employment, they sleep in the open or under very meagre shelter on nights when severe frost sets in after sunset. The two essentials of their existence during an expedition are a smoky fire and tobacco. Distrusting the efficiency of the European's matches (and not without some justification in this damp climate), they invariably carry their own cylinders of smouldering tinder. These are tightly bound with banana fibre and contain either moss or bark-cloth wrapped in dry grass, and are usually about 3 feet long at the start, gradually burning away to a stump.

[1] *Op. cit.*, p. 126.

Through river crossings and torrential rain, the tinder, in its tightly enclosed fibre container, smoulders on until the porter opens the end, blows it into flame, and starts his fire. On cold days this is customary almost every hour of the march, particularly when the porters see a difficult stretch of country ahead. Loads are thrown aside, and presently a huddle of figures can be seen inside the dense and whirling smoke of a groundsel fire, the dry leaves of which produce an intensely irritating smoke which the porters love.

From Bugoye to Nyanabitaba cave I fixed survey stations from which azimuth observations to the Portal peaks were made. From Nyanabitaba to Bigo rock shelter the dense mist and forest prevented observation, and we therefore hurried on, reaching the cave at Bigo on the third day. This camp overlooks the valley of the Bujuku river at its junctions with the Mugusu and Bukurungu rivers. Here a dump was made of the bulk of the food, and, as this also formed a convenient starting place for the Bukurungu valley and Portal peaks survey, a long series of barometric observations was made to establish the altitude of the camp. This was to provide a basic level in close proximity to the survey, which would help to decrease errors due to possible variations in atmospheric pressure in widely separated parts.

Food and clothing were then repacked for a bivouac on Mount Stanley, and on 27 May we left Bigo in a downpour of rain and walked up the Bujuku valley. The weather so far had been fair with occasional rain showers each day, and temperatures at 12,000 feet were between 5° and 8° C. with a relative humidity of about 90 per cent. The Bujuku valley, like all the valleys on this side of Ruwenzori, drops in terraces of 200–300 feet with level stretches of bog at intervals. The route ploughs through these, and in wet weather one exchanges the water cataract that is the path on the terraces for these dismal quagmires at innumerable intervals. We reached Cooking Pot cave above Lake Bujuku some time after midday 27 May and, after settling in the camp, went up to the Stuhlmann Pass. In the late afternoon the weather cleared. until eventually the sun appeared, and we were able to study the north-east ridge of Margherita which runs down to the pass.

We then spent several days in two unsuccessful attempts on Margherita. The first attempt was made by the north-east ridge and was abandoned owing to the slow going up the ridge. The following day we ascended Mount Speke by the main Speke glacier to the summit, Vittorio Emanuele. Visibility was only intermittently good, but during one clear spell we had a view of Mount Stanley and saw that a large ice-fall had taken place along our route to the north-east ridge. As the weather remained warm and close, our second attempt on Margherita was made by the Elena glacier, free from the menace of tottering ice séracs from the Stanley ice-cap. This attempt failed in a dense yellow fog which was followed by a fierce lightning storm and then by a slow-falling but heavy snowstorm.

The next morning was bright and clear, the sunshine reflecting on the new snow which spread nearly to the bottoms of the valleys. Before a mass of rolling cloud came up the valleys, I was able to fix the camp position and to take sights on the Portal peaks which were clearly silhouetted against a cumulo-nimbus backdrop. By nine o'clock we were overwhelmed once again in cloud and, deciding to give the weather a chance of changing, we packed

Typical vegetation in Ruwenzori: giant heath, giant groundsel, lobelia, and helichrysum

Phot. R. M. Bere

Bivouac at 14,000 feet on Mount Stanley with Mount Luigi di Savoia in the background

Phot. A. J. Haddow

Speke, Stanley, and Baker peaks (right to left) with East Bukurungu lake in the foreground

Phot. R. M. Ber

Lake Bujuku

camp. The porters were not due to come up with wood fuel until midday, so we left a dump of food and carried the loads down the ridge ourselves until we met them on their way up.

We retired that day down to Bigo rock shelter, and in the afternoon and evening packed fresh loads of food and the survey equipment with the intention of moving up the Bukurungu valley the next day and spending a few days exploring the Portal peaks. The following morning was pouring with rain and we all marched dismally up the valley, shouldering a way through the thick *helichrysum* and wet undergrowth and shivering with every fresh douche of icy water that fell from shaken branches. The porters, jubilant the day before at our return to 11,000 feet and slightly warmer climes, were despondent as always in the rain, but revived when we reached the head of the valley and chose a camp site almost on the pass which divides the Lamia and Bukurungu headwaters. Here they immediately set about building a stupendous smoke fire with dry groundsel logs.

Our new camp site overlooking the East Bukurungu lake (which the porters insisted on calling the Kihuma lake) was rather a bleak place without shelter from the wind, but on rare occasions it gave us a magnificent panorama of a large part of the range. Our greatest handicap was the spell of cold misty weather which lasted throughout our stay. The survey work was started next morning when we went down to the lake shores, chose a flat site, and measured a 600-feet base-line. After a check measurement, I started extending the triangulation to two small hills, while Bere and Ladkin cut a way up to the pass and started a smoke fire as a beacon which I could fix as a forward station. The mapping proceeded very slowly. The ground everywhere was running with water, and the earth was one vast quagmire on which it was extremely difficult to set up the plane-table. The greatest annoyance was the heavy dank fog which hung over the valley and peaks, very occasionally thinning out as a feeble, short-lived breeze puffed up. Each observation had to be seized in these moments, and then the fog would close over again, possibly for several hours, during which there was no rest while waiting for the next break.

One day, while I mapped the northern portion of the Portal peaks, Bere and Ladkin crossed the valley and made the first ascent of Kihuma, which is the highest point of the Portal peaks (14,640 feet). As I worked I could hear their progress up the steep, moss-grown slopes, until the sounds died out over the top of the ridge.

We continued the mapping until 8 June, when no more time could be spared if we were to make a final attempt on Margherita; about 50 square miles of the area had then been mapped. The position of the three main peaks, which are called Kihuma, the Middle Portal (for which no native name could be found), and Rutara, showed considerable variance from the accepted positions of the "North" and "South" Portals on any existing map. The mountain is shaped in plan like an inverted "Y," Kihuma standing at the northern end, the Middle Portal at the centre, and Rutara, which is an outstanding peak, on the left limb. The bearings taken by the Italian expedition from the Iolanda peak of Mount Gessi [1] appear to have intersected with other bearings on different peaks of the Portals. As Kihuma peak closely resembles

[1] *Op. cit.*, p. 356.

the Middle Portal in silhouette, it may well be that in cloudy weather the latter was mistaken for the most northerly peak. This however was not the only discrepancy, as appeared later. The question could not be settled until the observations from Mount Gessi had been repeated, and as there was now insufficient time the ascent of Gessi had to be left to a later expedition.

We then returned to Bigo, and next day, as the weather was good, we ascended the Bujuku valley direct to the high bivouac by the Elena glacier of Mount Stanley. We had a short night's rest, getting up at 2.30 a.m. and reaching the Stanley ice-cap as dawn was breaking. After breakfasting at the foot of Alexandra peak, we made our way up the Margherita ice-fall and on to the steep snow slopes leading to the summit, which we reached at midday after negotiating several large cornices. The final ascent was made in thickening fog, and on the return we had a certain amount of difficulty in locating the tent.

Our plans were now completed and, as leave had come to an end, we had to pack loads and start down the following day. The return down the Bujuku and Mobuku valleys was pleasant, and we reached Bugoye again on 13 June, dirty and unshaven and rather short of food. I was in Kampala and at my office the following day.

There still remained the question of the Duke of Abruzzi's observations of the Portal peaks from the top of Gessi, and with this in mind I managed to arrange for ten days leave in the following December. I planned to join the other two members of the party, R. N. Posnett and C. P. S. Allen, who had more time, by following them up to the base by forced marches. All arrangements were completed, and Allen and Posnett left Bugoye with fifteen porters on 1 December, the latter somewhat weakened by a bout of malaria. On the same day I contracted tonsillitis, and for several days of irritating delay ate M and B tablets under a doctor's direction. On 4 December, continuing the treatment on the road, I drove to Fort Portal, and by doing six stages in two days joined the party at our base in the Mijusi valley on the scheduled date.

Our aim was to climb Gessi by the route taken by the Duke of Abruzzi in 1906. Unfortunately thick mists had prevented Allen and Posnett from reconnoitring the approaches, and we were very uncertain of the exact line of access. This doubt was soon resolved when we found how difficult were the approaches on the west side of the mountain. At our first attempt we cut a way through the vegetation above our camp site and climbed to the south ridge which joins the ice-cap just below Iolanda summit. We reached the ridge at about 14,000 feet and started along the crest. There were no serious difficulties, although intermittently large towers and gendarmes forced us to descend from the ridge to left or right, and after seven and a half hours climbing, five of which were spent on the ridge, we reached the ice-cap in thick mist and with a snowstorm beginning. The slope stretched steeply above, disappearing into the flurries of snow, and visibility was very bad. As the time was now 3 p.m., and the position of the summit impossible to locate under these conditions, we had to turn. It was fortunate that we did, as towards darkness we missed the route off the ridge and spent a short anxious time wondering whether we were descending into the wrong valley; but

occasional compass bearings kept us right, and we finally wandered into camp, tired and hungry, towards six o'clock.

On the following day Posnett and I made a reconnaissance towards the Roccati pass. The thick mists were down as far as the valleys, and it was impossible to find or plan any fresh route. We moved camp nevertheless, as it appeared certain that the Iolanda glacier descended to a point not far above, and from the Duke's description it seemed that the route must be quite straightforward once this was located. We could not reach the snout of the glacier however as it had retreated up a steep gully, leaving ice-worn and rounded slabs, and as Posnett and Allen were not rock climbers it did not seem advisable to attempt it. Instead we left camp the next day at dawn and started to climb a 500-feet wall directly above. This was an evil moss-grown precipice, covered with wet mud and vegetation, up which we were led by false hopes until it seemed quicker to go on than to return and try another line. The cliff steepened above, so that we did not reach the top until after eleven o'clock, and by the time we reached the glacier at midday it seemed ill-advised to proceed farther with the possibility of having to descend the cliffs in the dusk.

A further reconnaissance showed that this band of steep cliff prevailed all along the western slopes, and that the recession of the glacier had formed a new obstacle to the ascent. It was therefore decided, as time was short, to move to the West Bukurungu valley and make the ascent from the east side up to the southern ridge which we already knew. This we did, and on 11 December we established a bivouac at 14,000 feet just under the crest of the south ridge. From here the way to the summit was clear, and on the following morning we left camp in the dark at 5.45 a.m. and climbed up to and along the ridge-top by the light of a hurricane lamp. At eight o'clock we were at the foot of the ice-cap and stopped for breakfast. The same dismal mist enveloped us and our surroundings, but with plenty of time in hand we were determined to quarter the ice-cap until the summit was found. We climbed to the crest, kicking steps in the snow, and, taking a rough compass bearing from the top, followed it until we hit exactly on a small rock peak. This proved to be the beginning of the summit rock ridge, and we proceeded along it jubilantly, though we had to descend to avoid the main towers.

At 10.15 a.m., after climbing a steep little snow gully and scrambling very cautiously over loose rock, we suddenly discovered that we had reached the summit, identified by the rock cairn erected by the Duke of Abruzzi's party. It was partly blown down but could be recognized from the photograph in De Filippi's 'Ruwenzori' (facing p. 268). Almost forty years later, on the third ascent of this peak, we took another photograph from the same position; for in the interval the sun miraculously came through the cloud, and very shortly after reaching the summit the thick mists cleared and we saw the whole range in magnificent panorama. A barometric reading was taken, and I managed in the clear interval to get a number of bearings, including some on the Portal peaks, fortunately visible on the edge of a mass of cloud coming up from the east. I exposed a number of films, but unhappily found later that owing to a defect a large number of prints were fogged.

As we were about to leave the summit for Bottego, we heard an airplane

and for several moments watched for its arrival. The massive clouds in the east however must have kept the pilot away as the sound soon receded. We afterwards heard that it was a Belgian passenger plane and that, as these airplanes have a ceiling of 20,000 feet, they frequently approach Ruwenzori for a view of the peaks.

The rock ridge of Gessi led us towards the peak of Bottego, about a mile away, and at midday, after a short rock climb, we reached the summit. It was the second ascent of Bottego, and we found intact a small cairn of rocks on the topmost boulder. From the summit, as the sky was still clear, I was able to complete the observations to the Portal peaks and, with a barometric reading for the altitude of Bottego, to finish the survey work. Shortly afterwards we left the summit and returned along the ridge. After almost two hours of clear view and sunshine we did not grudge the reappearance of mist, and lightheartedly followed our track down to the south ridge.

We regained camp just before four o'clock, and after a pause for tea, packed up and took the loads down to a camp site at 12,000 feet overlooking the Bujuku valley. Without incident we returned to Bugoye with the six remaining porters on 14 December.

A note on the survey

The survey was carried out with a prismatic compass and a locally made plane-table, and the form lines were based on spot heights determined by aneroid barometer or by computation from angles of elevation measured with an Abney level.

The base line, 584 feet long, was measured along the flat shore of the East Bukurungu lake, and was extended by triangulation to give several stations between 2000 and 3000 feet apart, from which the main observations on the Portal peaks were made. The base line and the nearby fixed points were tied to the existing survey by a series of compass bearings over an arc of about 80° on to peaks of which the coordinates had been determined by the Duke of Abruzzi. A magnetic variation of 4° 40′ was used. In addition to the local survey in the area of the Portal peaks, independent observations were made from Mount Stanley, from Bigo camp, from the survey stations established between Bugoye and Nyanabitaba, and on the second expedition from the summit of Mount Gessi.

Four aneroid barometers were used, but of these one proved to be unreliable and two would not register above 11,000 feet. A hypsometer was used as a check, and further checks were obtained by measurements with the Abney level on some of the peaks. The aneroids were compared with a standard mercury barometer before and after the survey, and the hypsometer error was ascertained with the kind assistance of the Physics Department of Makerere College, Kampala.

In comparing the results of this survey with that of the Duke of Abruzzi, a number of discrepancies were found. These concern mainly the Duke's observations on the Portal peaks from Mount Gessi, and the exact height of the Iolanda peak of Mount Gessi.

The geodetic observations made by the Duke of Abruzzi are tabulated in part II of Appendix B to De Filippi's 'Ruwenzori,' of which Summary A (p. 356) is a "List of triangles." Here there are curious discrepancies in the bearing intersections for the positions of the "North" and "South" Portals. It is clear that the observations from Wollaston were made to Kihuma and to Rutara, which are in fact the northernmost and southernmost peaks. From

Iolanda the Duke took two bearings, but the intersections of these with the Wollaston bearings are clearly in error. The bearing to the "North" Portal in this case seems to have been made to the Middle Portal, and I confirmed this fact from the summit of Gessi. The bearing to the "South" Portal is considerably in error and it is difficult to see to which peak it was made.

Summary C (pp. 358–9) is a table of relative heights observed by zenithal angle readings to some of the peaks and referred to Bujongolo. The observations to Iolanda from Cagni and Wollaston Stations are in error, which is apparent if the distances (given as "sides") are calculated from the given coordinates. There is also a misprint in the height ratio of Cagni station to Bujongolo. These may be corrected as follows:

	Zenithal angles observed	*Sides (metres)*	*Diff. of level*	*Ratio referred to B.*	*Corrected Sides (metres)*	*Corrected Diff. of level*	*Corrected Ratio referred to B.*
Cagni Station, mean ratio				772			722
Iolanda	+1° 39′ 30″	8142·9	+235	957	6469	+187	909
Wollaston Station							
Iolanda	+1 00	6968·2	+122	983	6026	+105	966

In Summary A (p. 356) the distance to Iolanda from Wollaston Station is given correctly as 6025·9 metres.

The third altitude determination made by the Duke for Iolanda peak was obtained by hypsometer reading on the summit referred to a barometer observed at Ibanda at the foot of Ruwenzori. This gave the height difference to Bujongolo as 972 metres. Unfortunately my own barometric observations on Iolanda and Bottego peaks proved valueless, due to a fault in the aneroid, and thus an interesting check was lost.

The height difference between Iolanda and the Middle Portal as ascertained from my survey is 1078 feet. Reducing to feet the Duke's figures for the relative height of Iolanda given above, the following comparison is obtained:

	From	*Altitude of station (feet)*	*Height diff. from Iolanda (feet)*	*Altitude of Iolanda (feet)*
Abruzzi	Cagni	14,826	+ 613	15,439
	Wollaston ..	15,286	+ 344	15,630
Hicks	Middle Portal ..	14,420	+1078	15,498
	Average			15,522

This average should be compared with the figure adopted by the Duke (15,646 feet).

On p. 221 of 'Ruwenzori' the following table compares the altitude determinations made barometrically by the Duke with those made geodetically by Lieut. T. T. Behrens in 1903 on the Anglo-German Boundary Commission.

	Height in feet above sea-level		
	Behrens	*Abruzzi*	*Difference*
Margherita	16,619	16,815	−196
Alexandra	16,543	16,749	−206
Edward	15,748	15,988	−240
Vitt. Emanuele	15,846	16,080	−234
Umberto	15,554	15,798	−244
Iolanda	15,258	15,647	−389

If the corrected figure for the altitude of Iolanda is adopted, the difference in the table is reduced to −264 feet, which is in the same region of differences as the other peaks.

The author wishes to acknowledge with gratitude the loan of instruments by the Uganda Survey Department and the B.E.A. Meteorological Service, and to thank Mr. R. M. Bere for his helpful criticism and advice.

A note on the meteorological record by Mr. L. C. W. Bonacina, *Foreign Secretary, Royal Meteorological Society.*

This record comprises weather notes taken on the two visits to the Ruwenzori range in May and June and in December 1945. For a number of stations whose latitude, longitude, and altitude are given, observations were taken daily at specified hours on the amount and type of cloud, visibility, wind, pressure, temperature, and relative humidity. Though there are some gaps in these columns, there is a complete system of general remarks on the weather experienced which much enhances the value of the meteorological record. Had such a record ranged over a full year, the cloud observations alone would have yielded valuable information concerning the altitudinal relationship of the different cloud-types to be encountered on an extremely cloudy, equatorial, mountain range. But, brief as the record is, there emerge two distinct tendencies which may be regarded as significantly in keeping with the fairly regular regime of tropical daily weather. In the first place there is a noticeable tendency for clear fine nights and early mornings to be followed by cloudy days with massive cumulo-nimbus developing with the heavier storms. In the second place there is obviously a lot of orographic cloud, fog, and drizzle which may shroud the mountains at any time of the day or night as damp winds spring up in association with changes in the general meteorological situation.

It is interesting to note that on Mount Stanley on 3 June 1945 a "dense yellowish" morning fog preceded heavy sleet which developed during the afternoon into a snow thunderstorm. After this snowfall, which covered the camp with about 4 inches of fresh snow, the snow-line descended from 14,500 to 13,000 feet. Similarly, on Mount Gessi on 8 December 1945, a heavy snowfall sent the snow-line down from 14,000 to 12,000 feet.

Despite the reputation of Ruwenzori for dense cloud canopy, clear sunny days certainly do occur, for there is a note to the effect that at 14,000 feet on Mount Stanley on 31 May, after a very fine and clear night with morning visibility reaching over 31 miles, very little cloud developed during the day and wet clothes dried rapidly in the hot sunshine.

[The meteorological record, together with a contemporary record from the nearest weather station at Fort Portal (by courtesy of the Director of the B.E.A. Meteorological Service) and a table of levels established during the survey, is being held at the Society's House—*Ed. G.J.*]

DUST-STORMS IN EGYPT AS NOTED IN MARYUT: A SUPPLEMENT

F. W. OLIVER

THE NOTES which follow form a supplement to the report entitled "Dust-storms in Egypt and their relation to the war period, as noted in Maryut, 1939–45," published in this *Journal* in 1945.[1] That report covered what may be regarded as an isolated episode in desert history: the rise and fall of dust-storm activity over a period of military operations with consequent abnormal disturbance and pulverization of the desert surface. Doubtless many deserts in the Middle East reacted in like fashion to the tramp of war, so that our experiences in the Egyptian Maryut can in no sense be unique; but under the circumstances it is unlikely that systematic records have been kept. It was the accident of continuous residence in a district of major disturbance that enabled the writer to compile, in some fashion, a consecutive account of the sequence of concurrent dust-phenomena over the period.

With the passage of yet another year (October 1945–September 1946) it has become possible to supplement the dust-storm calendar set out in the Report (p. 36), making seven years in all. It is now possible also to fill in certain omissions in the earlier paper, and to contribute some notice of a local flood of unusual magnitude which, within its well-defined limits, transported large quantities of desert dust from the higher ground to the low-lying flats.

Dust-storm incidence for the year 1945–46.—The dust-storm calendar (Report, p. 36) summarized dust-storm incidence over the six-year period October 1939–September 1945. The relevant dust-data for 1945–46 have since become available and are presented in the adjacent table. It will be observed that the record for this year shows a further drop to two standard dust-storms and five residual or sub-dust-storms (cf. Report, pp. 44–45). This accords with the drop in numbers first noticeable in 1943. It may be added that the wind velocities required to raise the relatively few storms of the period October 1945–September 1946 were in complete conformity with those obtaining in the

DUST-STORM INCIDENCE, 1945–46 [2]

Month	1945–46
October	None
November	*16*, *17*
December	13, 25
January	None
February	*13*
March	*2*
April	None
May	None
June	None
July	None
August	None
September	*19*
Total	2+5
Year's rainfall	205mm.

[1] *Geogr. J.* 106 (1945) 26–49. In this supplement the earlier paper is cited as "Report."

[2] This table is set out in the same form as the dust-storm calendar at p. 36 of the Report: figures give days of the months on which dust-storms were recorded; those in italics were sub-dust-storms.

later years of the previous period, as recorded in the Report.[1] For the two ordinary dust-storms, the mean wind velocity was 32½ m.p.h.; for the five sub-dust-storms, 25 m.p.h.

Though late in starting, the rainfall in the Maryut district was fairly copious (205 mm.), especially over the three winter months, December, January, and February. In consequence of this, a better-than-average seasonal flora established which, with the now depleted "dust-reservoir," finds expression in a further diminution in the number of dust-storms.

Soil migration.—In the Western Desert of Egypt soil migration is by no means restricted to aerial transport of desert dust, which in the main proceeds (especially under conditions of *Khamsin*) from south-east and south to north. Much of this must fall in the Mediterranean and on special occasions may even reach the continent of Europe.

Passing reference was made to the dunes which fringe our Mediterranean coastline (cf. Report, foot of p. 26). These dunes form a belt of varying width, sometimes approaching a mile. They consist of oval and spherical concretions of carbonate of lime (oolites), ranging from 0·15 to 0·8 mm. in diameter and averaging about 0·5 mm. Formed in the sea, the oolites are cast up on the beach and in due course drift inland under the prevalent north-west winds. The movement imposed on them is a process of hopping, like that of the silicious grains of ordinary sand dunes: thus they travel low, not floating at height like desert dust.

At the edge of the sea, just above high-water mark, the beach consists of pure oolites. A few paces inland a minute fraction of desert dust can be detected on screening—perhaps 0·1 per cent. by weight. Farther inland the dust-fraction increases, and may amount to 10 per cent. at the back of the dunes. Driven before the wind, these oolites pass the Treaty Road and gradually climb the slope of the outer Abu Sir ridge; crossing it, they descend in like manner to the edge of the lake-bed, which, being sticky, arrests their farther progress. The soils on this south-facing slope contain much larger fractions of desert dust—20, 30, or even 40 per cent. It is just these soils on the southern slope of the Abu Sir ridge (the "Flowery Way" on the map in Report, facing p. 29), and similar situations, that display the natural flora in its highest perfection, and likewise attract the planter of figs, olives, etc. The desert dust, which by itself would give a fine sticky clay, is ameliorated by the oolites to give an open-textured soil of adequate fertility, and also water-retaining, as the oolite fractions form a useful protective surface mulch.[2] Certainly on the sea frontage hereabouts there is no sign of the oolite production diminishing; the evidence is rather the other way, as these last few years the oolitic dunes have been advancing seawards about 1 foot a year: that is to say, more oolites are being thrown up than the prevalent north-west winds are able immediately to transport. Though not verified by the writer, it seems probable that the same "over-production" extends for many miles to the west. On

[1] Table 3 on p. 44 of Report happens to cover the February–September periods only: this however does not affect the validity of the statement above.

[2] In English farming literature are many references to the laborious and costly operations entailed in these mixings where natural processes do not cooperate, as they do in the favoured Maryut.

1. Flood of storm-water, Burg el 'Arab, 29 December 1945

2. Strips of "Mesembryanthemum" to control surface drift of dust, three years after planting

the other hand there are many less favoured sectors, as where cliffs form the edge of the land, or where lines of lagoons, as is often the case, run parallel to the shore; by such means is landward travel of oolites obstructed.

The fertility of desert dust.—It has been a matter of common observation during the period of increased dust frequency that where cultivation is pursued on watered or irrigated ground the products of cultivation have prospered amazingly. That the soil of Maryut holds virtue must be obvious to anybody who has visited the district in a showery spring when the natural wild flora is at its height. It is rich in species (*circa* seven hundred), of which the greater number are annuals, and in favourable seasons the flora carpets the ground of the coastal belt from end to end.

In these dusty years garden plants—that is, such as can tolerate an alkaline soil, have excelled themselves. This is true of all classes—bulbs, annual and perennial herbs, flowering shrubs, climbing plants, and trees. They have been outstanding in productivity and duration of flowering, size, colour, and fragrance of flowers. Olives and other staples have produced heavy crops, and melons from the local horticultural garden hold their own in flavour with, if not excelling, any raised in Egypt.

Air-borne dust is a fine powder having three principal components—a colloidal clay, some pulverized limestone, and a humus fraction, the last deriving from comminuted fragments of vegetable origin. This humus is doubtless the "carrier" which provides readily available nitrogen, and may be the key to the soil quality. Compared with the Nile silt of the Delta, the amount of available nitrogen is trifling. Expressed in parts per million, the figures are as follows: Egyptian Delta Soil, total N. 250–1500, of which 100 is readily available; Desert Dust (Burg el 'Arab), total N. 244, of which 22·4 is readily available. Maryut dust consequently ranks with the lower grades of Delta silts. But during the period of these studies the ground at Burg has enjoyed such frequent renewals of this top-dressing of dust as to offset appreciably the relative smallness of its nitrogen content. However this may be, there is a growing number among the Beduin population who are fully alive to the merits of the local soils.

Control of dust drift.—It is possible to have too much of a good thing, and a word may be added here on a simple method of controlling drifts of dust from windward which would otherwise pile up against boundary walls in the fashion shown in Plates 4 and 5 of the Report (facing p. 30).

The obvious cure is to plant successive parallel belts of suitable plants facing the direction from which these wind-driven rivers of dust approach. In a modest way experiments with this object in view were started in April 1941. The first agent to be chosen was *Mesembryanthemum crassifolium*, a creeping, quickly-establishing South African species (also of Western Australia) often found in Egyptian gardens, where it tends to be a menace if not controlled. Lines were planted 6 feet apart and required only a few waterings to establish. To form a line, cuttings were placed a foot apart and quickly covered the intervening spaces. Being evergreen this plant functions all the year round and practically requires no attention. *M. edule* (the Hottentot Fig) is more

bulky, and a line or two may usefully be added to frontages which are much exposed. A cold blustering wind in winter may occasionally blight a section here and there, but replacement is simple. Though constitutionally slightly less robust than *M. crassifolium*, *M. edule* compensates by being able to hold and assimilate more voluminous flows of dust. Should the unit lines tend to collect too much dust and thus rise too high, additional lines can always be added to windward.

In my experimental case a frontage 100 feet deep is available, but in five years' experience, six lines occupying less than 50 feet of the space available have sufficed. At 100 feet distance from my boundary wall a double row of *Tamarix arborea* was planted at the same time; it is now 10 feet high. This will afford additional shelter as it grows. The tamarisk is the real child of the desert, and when planted in quantity to windward of habitations contributes welcome shelter. The Nomad however is not manifestly amenity-conscious; it is only here and there that a tamarisk is to be found near his dwelling, and that hard-bitten and deformed and only suffered to remain for drying clothes on. Even official plantings are rarely respected, and goats are apt to destroy them.

It may be useful here to define precisely the intention behind the lay-out of dust-control strips of *Mesembryanthemum* shown in Plate 2. On the left is the arch leading into my garden: it faces west-south-west. The prevalent dust-driving wind in this instance strikes the gateway obliquely, from the north-west. It will be noticed that the arch is closed by an open-work iron gate. Without the protection of the control-strips, quantities of dust would drift through it into the garden. On the other hand, were the gate impenetrable, the dust would pile up as a bank in front with the result that in time the gate-way would become blocked. In practice it is found that the planted strips fix and control the greater part of the drifting dust, while such fraction as escapes is held by the addition of a *Mesembryanthemum* strip at the foot of the low wall facing the front of the picture. Should this bank in time grow inconveniently high, it can be removed and the *Mesembryanthemum* replanted at the original level. In all cases where protection against drifting dust may appear desirable, the actual plotting should be carefully planned in advance with especial relation to the lie of the land and the direction of the prevalent wind.

This rough anti-dust technique could no doubt be improved on by the selection and addition of other species of plants. Though admirable methods of employing plants for defence against wind in its various forms are to be found in places, the whole art merits detailed experimental study followed by authoritative reports on the results obtained; this is especially necessary where desert cultivations are involved.

Transport of dust by water: defluxion.—However efficient wind may be in lifting and dispersing dust, it is from time to time supplemented by local cloud-bursts on desert slopes and plateaux with consequent torrents of storm-water ("run-off" or "seil"-water) which descend to the low-lying grounds, carrying with them great loads of silt (*i.e.* dust) swept up in their headlong course to be deposited on the flat bottoms as the waters abate. This type of transport may be termed, conveniently, defluxion. The amount of deposit

left is copious as compared with that precipitated on an equivalent area by a single dust-storm; but as such intrusions are restricted, both in space and time, the total effect of defluxion over any period as compared with deflation is almost negligible. The gathering grounds of the silt-laden waters are limited to areas of the order of 30–50 square miles, while the wind picks up dust over areas desert-wide.

In twelve years of residence at Burg el 'Arab I have recorded five such floods of run-off inundating the low ground in the vicinity, and especially the horticultural garden which occupies the low ground on the east side of the village. These floods occurred on 13 January 1937, 24 December 1941, 28 December 1942, 1 December 1945, and 29 December 1945. Of these, the first three did not exceed 2 feet in depth; they subsided within thirty-six hours, percolating into the soil. That of January 1937 is represented in Plate 3 of the Report (facing p. 28).

The two floods of December 1945 were of much greater volume. That of December 1 rose to a height of 3 feet outside my garden, and penetrating the ramparts stood within to a depth of 2 feet. When, after forty hours, it abated, it left behind a heavy silt, $^2/_5$ inch thick when it dried out as a crust. The flooding outside may have extended to 30 or 40 acres. Following this, before daybreak on December 29, a second flood was ushered in by a severe thunder-storm or cloud-burst on the high ground to the south. By midday this flood occupied some 100 acres in the vicinity, with marked extension to the east, where the village of Bahig was seriously inundated. In my garden on this occasion the water stood at 3 feet or more: outside it was much deeper. The silt left by this second flood was $^1/_5$ inch thick on drying out. Thus the contribution of these two December floods was $^3/_5$ inch, or at least $^1/_2$ inch.

Plate 1 was taken at high water from a point high up in the round tower shown in the centre of Plate 3 in the Report. The depth of water in the foreground, in front of the hedge, was $4^1/_2$ feet. The waters were yellow, turbid to capacity; the dark streaks on the surface are humus elements washed out of the suspended silt. The hedge consists of bushes of *Schinus terebinthifolius*, the trees are tamarisks, and the scattered, almost submerged bushes are olives. All these plants have prospered since their immersion.

I estimate the weight of silt per acre left by the flood of December 1 to be 70 tons, and that of December 29, 35 tons: a total of perhaps 100 tons per acre. This silt is merely consolidated dust, and when pulverized is indistinguishable from air-borne dust. At pages 34–35 of the Report estimates were given of the rate of fall of dust from dust-storms of varying density. In an average case this would be of the order of $^1/_4$ ton per acre per hour. For such a dust-storm having a duration of six hours, the total contribution would be $1^1/_2$ tons per acre. Assuming the aggregate of water-carried silt deposited on the low ground flooded in both December floods to have been 100 tons per acre, the accession of dust was roughly equivalent to that brought by sixty-six average dust-storms, *i.e.* somewhat more than that recorded for the whole year 1940–41 (cf. table, p. 36 of Report). Within its restricted limits therefore, defluxion must have appreciable significance as a fertilizing agent of low-lying ground. It may be added that the flood of 29 December 1945 far exceeded in depth any previous flood in local memory.

Where defluxion supplements deflation the effects may be spectacular. This was compactly illustrated in my own garden by the floods of December 1945. While the lower levels received a top-dressing of about ½ inch of silt, the higher parts not reached by these floods received none. The contrast became strikingly evident within three months: vegetative activity, growth, abundance and duration of flowering, followed by an unusually prolific yield of seed characterized the lower levels. In support of this general statement a single example may be cited. There are several established patches of the South African asclepiad, the succulent *Stapelia gigantea*, each regularly producing three or four flowers exceeding a foot in diameter. One of these patches, covering about a square yard, which was loaded with silt in the floods of December 1945, expanded 53 flowers in September 1946. Elsewhere, above the silting level, other patches behaved as in former years—a flower here and there.

In general the little trees of this lower garden displayed an almost wanton growth and ramification after flooding, and an awakening of buds usually dormant. In this connection mention may be made of the reaction of some specimens of the Century Plant or American Aloe (*Agave americana*) which, since attaining adult dimensions with leaves 6 feet or more in length, have been producing on an average five offsets per annum from underground runners at the base. By September 1946 this production of offsets had greatly increased in all cases, notably in a blue-green variety where over fifty offsets were counted surrounding a single plant. In the variegated forms with striped leaves twenty-five to thirty offsets were usual.

HUMAN CULTURES AS ADAPTATIONS TO ENVIRONMENT

THE PREHISTORIC FOUNDATIONS OF EUROPE TO THE Mycenean age. By C. F. C. HAWKES. *London: Methuen*, 1940. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xvi+414 *pages; illustrations, diagrams, and maps.* 21*s*

DATING THE PAST: an introduction to geochronology. By F. E. ZEUNER. *London: Methuen*, 1946. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xvi+444 *pages; illustrations, diagrams, and maps.* 30*s*

BRITISH PREHISTORIANS, thanks to Myres, Crawford, Fleure, and Fox, have been taught to treat their "cultures" as human adaptations to environments and hence to pay proper attention to the latter. All archaeologists who deal with the early phases of man's activity on the Earth are aware that the environment has varied with time as it does in space. This geographical outlook is consistently maintained in both these books. Zeuner indeed has more to say about environment than about human culture. He does however offer some suggestions as to how the differences between Lower Palaeolithic cultures (or industries) may be conditioned by environmental and ecological factors; suggestions that are novel in English though adumbrated in German by Menghin. Zeuner's main concern is to show how events in human history, and even before man emerged, can be dated in terms of calendar years without reference to written records. Apart from tree-ring dating, elaborated and so far applied only in North America, to a clear exposition of which the first chapter is devoted, the chronometers are geological and astronomical: the annual bands of sediment deposited as varved clays by the melt-waters of glaciers provide an accurate time-scale for the post-Pleistocene epoch; fluctuations in effective solar radiation for earlier ages. But the results of human activity cannot be directly dated by either method. It is climatic changes that can be dated while the human cultures can in turn be assigned to climatic phases. Hence in both cases the author has to devote much space to the reconstruction of the environment in which prehistoric societies acted. In this he invokes, in addition to the now familiar methods of pollen-analysis, palaeontology, and stratigraphical geology, methods of soil study not hitherto utilized by British or French archaeologists. At the same time he displays a mastery of the older as of the new techniques that is seldom combined with archaeological competence in this country.

For the geological Pleistocene, the archaeologists' Old Stone Age, Zeuner's chronology depends on the assumptions that the outstanding geological events of that epoch—the ice ages—are correlated with the fluctuations in solar radiation reaching latitudes 55°–65° (N. or S.) in summer and that these fluctuations are due to perturbations of the Earth's orbit. In contradistinction to Croll, Drayson, and Ball, Zeuner follows Milankovitch in considering the combined result of variations in the obliquity of the ecliptic, the eccentricity of the Earth's orbit, and the heliocentric length of the perihelion. Milankovitch has calculated this effect in conventional units, and expressed in graphs the effective radiation consequently received at different times in the past by the several climatic zones in summer and winter respectively. Zeuner assumes that minima of summer radiation in the latitudes 55°–65° coincided with ice ages. If it be admitted that there were in reality nine glaciations instead of the four usually accepted in archaeological text-books, the coincidence between glaciations and the minima

of summer radiation expressed in Milankovitch's curve is quite impressive. Now German glaciologists had quite independently come to the conclusion that Penck's and Bruckner's Günz, Mindel, and Riss were in fact double, and Würm triple rather than double. (Incidentally the author has felt bound to replace these familiar names by the terms "Early," "Antepenultimate," "Penultimate," and "Last.")

Accepting these conclusions, it becomes possible to date in years, or at least millennia, before the present the several recognized Palaeolithic cultures in so far as their relation to ice ages is known, for the curve dates the glaciations with astronomical precision. Zeuner admits, but does not further consider, a possible "retardation" of the order of even 20 per cent.: it would not seriously modify the orders of magnitude involved in the antiquity of the Old Stone Age. Of course the correlation of Palaeolithic cultures with any specific glacial or interglacial is still hotly disputed even in the well-explored European areas adjacent to the actual ice sheets. In these periglacial areas, Zeuner, using his own observations on crucial English and German sites, reaches a "long" chronology not seriously discrepant from that of Breuil and his disciples. In the still more debatable areas outside the immediate influence of the ice, the author treats the correlation of pluvials with glacials with greater reserve than certain of his English colleagues, and finds better prospects in the "raised strands," first studied by Déperet and now proved to be world-wide. He infers that the high sea-levels they denote reflect the melting of the water at other times locked up in glaciers, and therefore correspond to interglacials. But though Zeuner accepts the assignment by Sandford and Arkell of several Palaeolithic industries to particular terraces in the Nile valley that has been recently queried in America, he frankly admits that the chronology of the African and Asiatic Palaeolithic is still very tentative.

Just over half the book is devoted to the old Stone Age and its environment. But Zeuner also gives a good and critical summary of the work of de Geer and his followers on varved clays that constitute the best chronometer of post-Palaeolithic events, and of the climatological and palaeobotanical investigations by which the varve record is linked with the archaeological. But here Zeuner is traversing ground made familiar to English readers by Dr. Grahame Clark (especially in 'The Mesolithic settlement of northern Europe'), and has unluckily been unable to use the revolutionary results of Danish and Swedish excavations and research first published since 1939. Still more unfortunately he uses the term "neolithic" to describe the Ertebølle culture of Denmark—and almost any post-Palaeolithic culture—contrary to the usage of all archaeologists in the English-speaking world, France, and Denmark.

Finally some fifty pages are devoted to the 15,000,000,000 odd years prior to Man's explicit emergence, and to estimates of the absolute age of the several pre-Pleistocene epochs and eras and of the Earth itself. While again not original, these two chapters illustrate the extraordinary range of the author's erudition; the discussion of radioactive methods, for instance, is the excuse for a really brilliant summary of the process of disintegration, illustrated by neat and illuminating diagrams. In any case this section is not irrelevant to the main theme and purpose of the book. One purpose certainly is to provide material for the discussion of the rate or tempo of the processes of history, natural and human.

His biological training qualifies Zeuner to discuss the rate of evolution. The treatment of organic evolution in chapter XII is confessedly sketchy, but gives full weight to the influence of environmental factors and makes effective use of modern genetics. Fuller and more relevant to this *Journal* is the discussion

of human evolution in chapter IX, B. The *Pithecanthropos* groups are here admitted to be over 500,000 years old—between 590,000 and 435,000 years before the present. The Neanderthaloids appeared, with the Mauer jaw, near the latter date, and survived till 110,000 years ago. Immediately thereafter *Homo sapiens* appears unmistakably in Europe, but Zeuner, like most British and some Continental anthropologists, believes that ancestors of neanthropic type must have existed somewhere much earlier. Like Hawkes, he accepts the fragmentary skull recently unearthed at Swanscombe as proof of this theory, but its testimony is in reality not so unambiguous as Zeuner's phrase on page 280 and Hawkes' on pages 11 and 18 might suggest to readers who have not read the original Report and foreign discussions. For the historian however, the most exciting section is that devoted to the rate of technological progress.

It is salutary, but by no means surprising, to learn that the classical Lower Palaeolithic hand-axe cultures, Abbevillian and Acheulian, lasted over 350,000 years—from 500,000 to perhaps 120,000 years before the present. Prehistorians may be more startled to read that distinctively Upper Palaeolithic cultures became manifest 100,000 years ago and that the Magdalenian lasted 50,000 years, for these cultures are the products of "modern" men, anatomically barely distinguishable from ourselves, as well equipped for hunting as some contemporary savages, and in some cases more expert as sculptors or painters. Yet within this century of millennia archaeology discloses scarcely any important technological inventions or improvements in artistic expression. Perhaps this is not so surprising after all. The known Upper Palaeolithic cultures were very efficient adjustments to environmental conditions which persisted over vast periods. Whether or not one accepts the astronomical theory espoused by Zeuner, geologists seem agreed that the duration of the last ice age must have been of the order deduced by Zeuner. Whether it were actually 90,000 or only 30,000 years makes little difference when it comes to comparing the rate of progress then with that historically attested and dated during the last 5000 years. The surprising thing is the catastrophic difference in tempo. It can hardly be explained by environmental changes. Historical factors of a distinctively human kind must be invoked. One is summed up in the phrase "the interchange of ideas between societies adjusted to different environments." Whether the mechanism was "migration" or "diffusion," this pooling of ideas is very clearly attested in the Near East from 4000 B.C., and in Europe from 2500 B.C.

It forms the central theme of Hawkes' book. The Palaeolithic and Mesolithic of Europe are here summarized in fifty-five pages, with four text-figures and one plate—sufficient to disclose the distinctively European features that were handed on to the new societies that did not, on Hawkes' "historical" chronology, emerge before 3000 B.C., save round the Aegean. It is to these precocious townships of the Aegean and the peasant societies of the western Mediterranean and temperate Europe that Hawkes' book is mainly devoted. The continental societies were sufficiently isolated and sufficiently sedentary to develop very quickly individual cultures distinguished by a bizarre variety of ceramic styles, burial rites, and even house plans. The author's conscientious attempt at least to mention all the small local groups thus distinguished by archaeologists inevitably makes the picture seem confusing, despite a number of plates and sketches, several maps and tables, and an abundance of cross references.

But these societies were neither completely isolated from one another nor completely sedentary. At first it is mainly resemblances in pottery and tomb plans that disclose their interrelations. So the complicated investigation of these rather tedious technicalities is essential to a book that is to disclose, not the bare deductions of one prehistorian, but the sort of evidence on which these are

based. The evidence is essential to convince the reader. No one indeed who has read of the Polynesians' voyages will be inclined to question considerable navigation on the Mediterranean in the Neolithic stage. To win credence for comparable voyaging along the Atlantic coasts from Portugal to Orkney and thence to Scandinavia, it needs the detailed agreement of tomb plans and vases marshalled by Hawkes. This documentation is then illumined by the vivid phrase "the potent religion which inspired this treatment of the dead was to the main current of westerly trade and adventure a thing as vital in its own way as the Catholic religion was to the Spanish adventurers in the Indies, Mexico and Peru." In the next archaeological period, but only then, East Mediterranean trinkets from graves in Wessex and British products imported into Crete demonstrate concretely for the mid-second millennium that long-distance intercourse inferred rather precariously from similarities in the third.

Hawkes is a diffusionist and holds that both the basic techniques of cereal cultivation and stockbreeding, and later the arts of metallurgy, were developed in the Near East and thence diffused in this continent. But he is at pains to show that "from the Danubian Neolithic to the Mycenaean Bronze Age the result was characteristically no second-hand reflexion of eastern achievement, but an integration of eastern with native elements in something essentially new." In reiterating this point Hawkes is stressing a geographical fact of immense historical importance. In history, the Oriental empires that have followed one another from Sargon of Agade to Jenghis Khan have been basically repetitions; Hellenism, the Roman Empire, feudalism, the absolute monarchies, and bourgeoise democracies in Europe are political labels for distinct modes of life and novel technologies. It was the same in prehistory; for instance, the European bronze industry shows more progressive development than the Oriental, but in half the time. Our author expresses this peculiarity as "the European balance," but the reviewer doubts whether he has made its nature clear or even rightly defined it. He writes, "We need to consider Mycenae as the seat of an essentially European culture—that is, essentially European in a sense in which Minoan culture was not." To many however, Minoan Crete itself appears distinctively European, save for the half-century when the lord of Knossos succeeded in creating an ephemeral and miniature Oriental Empire.

Be that as it may, Hawkes has produced the most coherent, detailed, and comprehensive, if not the most lucid, prehistory of Europe that has appeared in any language. It is based on a minute knowledge of a cumbersome and scattered literature. It is therefore much to be deplored that, instead of footnotes, only a general list of authorities for the several sections is given and grouped at the end, so that serious students cannot reap the full benefit of Hawkes' digest and follow up specific points to their obscure periodical sources. The same defect to a minor degree mars the form of Zeuner's work. If I wish to follow up the reference "Moir, 1924" given on page 185, I have to look back to ascertain which chapter includes this page and then turn to the end and find the bibliography, extending over several pages, for the chapter in question.

V. G. CHILDE.

TIBET AND ITS RULERS

PORTRAIT OF THE DALAI LAMA. By Sir CHARLES BELL. *London: Collins*, 1946. 9×6 *inches; 414 pages; illustrations and end-paper maps.* 21*s*

LATE IN the autumn of 1921 Sir Charles Bell, the first European to visit Lhasa by invitation, brought to a close a residence in the Holy City which had lasted nearly a year. The last words of the Dalai Lama to Bell were "We two are men of like mind." In some four hundred closely packed but easily read pages, Sir Charles Bell shows how it was that he and the Thirteenth Dalai Lama came to be men who could open their minds to each other and what it was that they had at heart—the desire and claim of Tibet to live its own political and religious life.

Bell was born in 1870. From Winchester, where he was a scholar, he passed into the Indian Civil Service, spent two years at New College, Oxford, and was appointed to the Province of Bengal. Nine years' varied routine work gave him experience which was to prove of value, especially in his work in Sikkim, but the climate of the plains was too much for his health, and in 1900 he was posted to the Darjeeling district. Since 1889 Claude White had been doing fine work in gradually bringing the Sikkim State into touch with the modern world and in establishing good relations with Bhutan. After twice acting as Political Officer in Sikkim during White's absence, Bell succeeded him in 1908. In 1918, contemplating retirement, he took leave which he spent in Darjeeling, collecting material for the books which he had in mind. In 1920 he consented to return to duty and, at the urgent and repeated invitation of the Dalai Lama, visited Lhasa, where he stayed nearly a year. He retired in 1921 and devoted the rest of his life to writing his books on Tibet. Already in 1905 Bell had published a Tibetan Grammar and an English-Tibetan Dictionary, later editions of which are still the best guides to the spoken language. His 'Tibet past and present' was issued in 1924, 'The people of Tibet' in 1928, and 'The religion of Tibet' in 1931. In 1933–35 he revisited Tibet and travelled in Mongolia, Manchuria, and China. In order that he might complete the present volume without distractions, he moved in the spring of 1939 from England to British Columbia, where he died in 1945.

Our present relations with Tibet arise out of the Younghusband Mission of 1903–04. The Dalai Lama in later years more than once indicated that if he had been more fully informed and had been a free agent at the time this Mission, or rather armed expedition, need never have advanced on Lhasa. But it sometimes happens that what matters most is not what is done but the way it is done, and the admirable conduct of the British and Indian troops which accompanied Younghusband, and the character of Younghusband himself and of others such as O'Connor who acted as his chief interpreter, left at Lhasa an impression not only of the power of British arms but also of goodwill.

Before Younghusband's advance the Dalai Lama, then aged twenty-eight, fled to Mongolia and later to China. On his arrival in Pekin in the autumn of 1908, he was received by the Emperor, and certain promises were made. Returning to Lhasa in December 1909 after a journey of nearly a year, the Dalai Lama found himself and his capital threatened by the advance of Chao-Ehr-Feng, who had been behaving with cruelty amounting to barbarity in eastern Tibet, where he destroyed many monasteries. In February 1910 the Dalai Lama fled to India. Bell, who had been negotiating a treaty whereby

Bhutan placed its foreign relations in the hands of His Majesty's Government, hurried back to Darjeeling, where a house was placed at His Holiness' disposal by the Government of India. Within a month the Dalai Lama had an interview at Calcutta with the Viceroy, Lord Minto, in which, following up telegraphic requests which he had made even before he reached Lhasa, he invited British help in order to effect an adjustment with China.

To this request for interference the British Government were unable to accede. But the idea which established itself in the mind of the Dalai Lama and was never to leave it—and so close did association between the Dalai Lama and Bell become that no doubt, in this as in other matters, they were "men of like mind"—was the need of establishing a Tibet which should be free, but on good terms both with India and with China. As His Holiness was to record in his Political Testament, written in 1932 about a year before his death, "The Government of India is near to us and has a large army. The Government of China also has a large army. We should therefore maintain firm friendship with these two; both are powerful."

The first of the line of divine priest-kings who came to be known, to the world rather than to the Tibetans themselves, as the Dalai Lamas was Gedun Trup-pa (1391–1472), nephew of the great religious reformer Tsong-ka-pa and first Grand Lama of the Drepung monastery near Lhasa. The third incarnation propagated the faith in Mongolia and received from Altan Khan the title of Dalai Lama. The "Great Fifth" Dalai Lama (1617–82), visiting Pekin where the Manchu dynasty had recently become established, was received by the Emperor as an independent Sovereign. It was not until 1720 that the Chinese, profiting by dissensions within Tibet and between Tibet and Mongolia, began to dominate Tibet.

In the eyes of the Dalai Lama, the Chinese revolution of 1911, which brought about the rebellion of the Chinese garrisons in central Tibet and their evacuation via India to China, broke the personal relationship of religious teacher and defender which had subsisted between the Manchu Emperors and the Dalai Lamas, and cancelled any claim which China might have established to dominate Tibet. But the Dalai Lama—and here again he and Bell were men of one mind—was quick to seek reconciliation. Returning to Tibet in 1912, he readily assented to a tripartite Conference in Simla in 1913 in which his Prime Minister, Lönchen Shatra, represented Tibet, Mr. Ivan Chen, China, and Sir Henry McMahon, Britain. Bell acted as Sir Henry McMahon's expert adviser on Tibetan affairs, and Archibald Rose on Chinese affairs. At the outset of the negotiations the British representative declared that the Conference started with a clean slate, a state of war having cancelled any previous agreements. The Dalai Lama held consistently to the end of his life that Tibet had never assented to domination by China. In the spring of 1914 the three plenipotentiaries initialled an agreement whereby Tibet acknowledged a form of suzerainty on the part of China in return for actual autonomy; but the Chinese Government took a step which in those days was perhaps without precedent and repudiated the action of their plenipotentiary. And there, in spite of repeated further efforts, the matter remains to the present day.

Such is the main political thread which runs through the book. But in order that the Dalai Lama and his policy might be intelligible it was necessary to write also of Tibet, its climate, and its crops; of its people, their history, and characteristics; of the Tibetan form of Buddhism and the place it holds in every home. All of these subjects are dealt with adequately and clearly. In the sphere of geography this book breaks no new ground. But it does correct some popular delusions. Situated as they are in about the same latitude as Delhi and Cairo,

the more populous parts of Tibet are not colder in winter than such places as Kabul and Meshed. Wheat can be grown as high as 14,000 feet and barley at 16,000 feet. The main axis of the eastern Himalayan chain is not the uninterrupted barrier to human intercourse which it appears to be on the map. Double-page end-papers contain sketch-maps which show the position of Tibet in relation to the rest of Asia, and the whole of Tibet. The latter map does not indicate the main trade routes. There might with advantage have been added maps on a larger scale of central Tibet and of the country near Lhasa, and also a plan of the city of Lhasa. If the demand for the book proves to be as great as it deserves, it would perhaps be possible in a second edition to substitute for the sketch-map of Tibet a map really worthy of the book.

Had Bell outlived the completion of this work, he might out of the fulness of his knowledge have made an important contribution to geography in a direction in which it is much needed—the rendering of Tibetan place-names in Roman script. That he had a flair for such work is indicated by his fondness for explaining the meaning of Tibetan place-names. Perhaps in this book he gives that fondness too free scope. To take a place-name familiar to Europeans, Bosporus may have the same meaning as Oxford, but to call it Oxford would be confusing; and something seems to be missed when Drepung, the greatest monastery in the world, is constantly referred to as Rice Heap Monastery.

In one matter Bell was hampered by lack of knowledge of other parts of the Indian frontier. If he had ever served on the North-West Frontier, it can hardly be doubted that when the Dalai Lama applied to him for advice on military matters he would have advocated, not training on regular lines, but something more of the nature of the frontier militias or levies.

Bell states in the Preface that Tibet is generally hostile to the foreigner. Such indeed must have been the impression which the Tibetan policy of exclusion suggested during most of the two hundred years which preceded Bell's visit to Lhasa, and any change which has occurred since that visit is in large degree attributable to Bell. But those two hundred years were the period of Chinese ascendency. It was with a loyal but sore heart that in 1721 the Jesuit Father, Ippolito Desideri, obeyed orders of recall from a country where he had been welcome and which he had learned to love; at no period do Indian pilgrims appear to have been discouraged from visiting Mount Kailas, or Indian traders from conducting business in western Tibet; in recent years the Tibetan Government has repeatedly given permission for Everest Expeditions and has helped them on their way; and at the present time it is in Tibet, more than in any other foreign country of which I have knowledge, that the Britisher who has the good fortune to serve there finds himself made welcome and admitted even to the intimacy of home life.

Such are the frame and background within and against which the portrait of the central figure stands out clear. Born some six years after Bell and dying some ten years before him, the Thirteenth Dalai Lama knew little but adversity during the first thirty-six years of his life. From then onwards, for twenty-one years, his authority was unquestioned and he became more and more an autocrat. The child of humble parents, he discharged his triple role as God, Head of the Church, and King with a thoroughness such as none of his predecessors had achieved. And yet throughout he displayed a humility without which perhaps he could not have achieved greatness and certainly could never have been a man of like mind with Bell.

B. J. GOULD.

REVIEWS

EUROPE

PHYSICAL SURVEY OF MERSEYSIDE: a background to Town and Country Planning. By WILFRED SMITH. *Liverpool: Liverpool University Press*, 1946. 8×5½ *inches;* 98 *pages; maps and diagrams.* 5*s*

This book was first prepared as a report to the Ministry of Town and Country Planning. The Ministry not only has its own research officers, many of whom are trained geographers, to collect, analyse, and interpret the factual data of the physical and cultural landscape, but also calls in specialists to report on such topics as national parks, coastal survey, and derelict land, all of which have at one time been subjects of papers in the *Journal*.

This little book comprises a detailed analysis of the geology, the relief and topography, and the climate of Merseyside, in which are included the undulating terrain of south-west Lancashire and the central and northern parts of Wirral. The effects of these factors on the distribution of population, the growth of settlement, the cultivation of land, the location of industry, and the development of transport are considered in both time and place. We see man's search for the dry, drift-free sites from early time down to the suburbia of the twentieth century when the buildings and factories of Liverpool and Birkenhead had sprawled on to the heavier boulder-clay lands. To trace the story as it is unfolded in this book one needs to be armed with large-scale geological and topographical maps, for the small-scale sketch-maps provide only the outlines. As their reward, the geographer will learn the trends of the physical evolution of the area, and the planner will acquire a knowledge of the physical factors which must influence the form of the plans for the development and re-development of Merseyside.

D. T. W.

PLAN FOR KINGSTON UPON HULL. By EDWARD LUTYENS and PATRICK ABERCROMBIE. *London and Hull: Brown and Sons*, 1945. 14×11 *inches;* xii+92 *pages; maps, diagrams, and illustrations.* 15*s*

This is a lavish production, in keeping with many Plans devised in recent years. Its chapter headings, its numerous maps, drawings, and excellent photographs whet the appetite of those anxious to study proposals for the future of this important but much-bombed seaport with its interesting historical background and economic set-up. An examination of the illustrative material of the Plan leads without doubt to some understanding of the physical character of Kingston-upon-Hull, of the devastation caused by bombing, and of the problems to be faced in any future planning within the city. When the quality of this illustrative matter is generally high and is attractively presented, it is disappointing to find certain weaknesses. For example, the map opposite p. 23 represents a survey of the change of industry in Kingston-upon-Hull over the period 1929–39, but it is in part undecipherable through a faulty choice of colour for some of the symbols. The land utilization map opposite p. 78 has no date other than "A.D. 1299–A.D. 1944" used as a general title to all the maps. Presumably this map, in common with other maps of the Land Utilization Survey, is a record of conditions at a particular time, and surely this should be stated. There are a number of small errors in the text whose presence is equally irritating. There is, for instance, a triple misspelling of Professor Rudmose Brown's name, while the statement on p. 28 that the A.1. road passes to the east of Hull makes strange reading. Much more serious however are the omissions or over-simplifications

of facts strictly relevant to any proper consideration of the character and problems of the city for which this Plan is intended to provide a long-term guide.

Before the preparation of the Plan was begun, a civic survey of Kingston-upon-Hull was organized by Mr. Max Lock. Unfortunately the results of this survey have not been made generally public other than by an exhibition. In the 'Plan for Kingston-upon-Hull' there is reference to this survey, and the subject headings of it together with a number of quite simple and obvious facts are given in Chapter 2. It is however difficult to discover to what extent the material from the survey has been used in the preparation of the Plan. In the absence of the considerable quantity of survey work that certainly was produced by Mr. Max Lock and his colleagues, one cannot adequately assess the proposals for future planning. The statement on regional relations on p. 1 leads one to expect in later pages concrete evidence that the present and future problems of the port have been assessed not only in terms of the precise locality but also in relation to the region in which it lies and the hinterland it serves. Unfortunately, the inadequacies of certain of the supporting evidence of the Plan are very apparent. They are seen in the sections on transport and trade and in the simplified data on employment where, for example, figures of insured persons attached to industry groups are given but without any exact date. The chapter on land classification and utilization stands in relative isolation and so contributes to the feeling that the full approach which the problems of this important port so clearly demand is lacking. These deficiencies cause doubts to arise; for instance, as to the soundness of the project for the proposed satellite at Burton Constable; whether this is the right place for such a costly development; and, as in other proposals made for the establishment of satellite towns, whether sufficient attention has been given to the industrial component. Without sufficient industries to provide adequate employment, satellite towns such as this can be but outlying dormitories to their parent cities and so productive of yet another group of problems.

Where the subject-matter is concerned with such technicalities as the very necessary changes to be effected in the railway lay-out of Kingston-upon-Hull and the elimination of the numerous level-crossings that have so long disturbed the flow of traffic over the present road system, one need be far less critical. But here again the absence of much that presumably resulted from the earlier civic survey is to be regretted.

Such publications as this, however attractively produced and however skillful the work of draughtsman and artists, emphasize that the proposals must show the supporting facts. Those charged with administration bear increasing responsibility as planning legislation multiplies and becomes the more embracing. In earlier years the execution of a Plan might well be so long delayed that a large measure of idealism, often extremely doubtful of realization, might be expected. If present-day planning legislation means anything, then harsh realities and practical contingencies must be considered against a background of financial expenditure. This Plan, like others, proposes a stage-by-stage execution of the proposals. In future publications, especially when they so obviously bear evidence of costly production, not only the Plan as a whole but its stage-by-stage execution must be assessable through the inclusion of the balanced evidence provided by both local and regional surveys. G. H. J. D.

LANGUAGE AS A SOCIAL AND POLITICAL FACTOR IN EUROPE. By STANLEY RUNDLE. *London: Faber and Faber*, 1946. 8½ × 5½ *inches;* 207 *pages; sketch-maps.* 12*s* 6*d*

Mr. Rundle's book is a review of the present distribution of languages in Europe, and a consideration of its bearing upon the international difficulties due to

language. After a clear analysis of these difficulties he discusses them country by country and then language by language, and considers the possibility of overcoming them. He discerns no easy solution but believes that there are already certain international facies of language in Europe, and that the barriers within each of the dominant groups of European languages (Romance, Teutonic, and Slavonic) could be appreciably lowered. He suggests some features of such artificial media as Esperanto, Basic English, and Speedwords as desirable in any language of wider currency than those in existence. If such a language is evolving in western Europe, it could be consciously assisted in its growth.

The book is very modest in its claims but is exceptional in the closeness of its reasoning and the logic of its development. This makes it a pleasure to read, apart from the fascination of the subject matter. It contains little which will be new to students of the geography of language, but the map on page 43 (Fig. 2), showing the intensity of the language frontiers of Europe, is an original and useful contribution to the subject. The frontier between Basque and its neighbours should however be intensity 5, not 2.

The book as a whole reflects the very unsatisfactory state of linguistic geography. Mr. Rundle has sought carefully for statistics but many of the figures, though the best obtainable, are old, many are given in round numbers, and others are based on estimates. Few references are given and there is no bibliography. The maps, though satisfactory on the whole, have lost in reproduction and are therefore harder to read than they need be; and they are not well placed, either for reference or comparison. One is referred always to Fig. x, when the addition of the page number would have saved the reader constant trouble. The authority for the maps is not stated, but they bear more resemblance to Stanford's 'A sketch-map of the linguistic areas of Europe' (50 miles to 1 inch, London, 1917) than to Haberlandt's 'Karte der Völker Europas nach Sprache und Volksdichte' (1 : 3,000,000, Vienna, 1928). Some of the information is oversimplified, particularly for Russia. The boundary between Greek and other languages in Turkey and Bulgaria (Fig. 3, p. 66) is open to question. And the condition within one or two countries of one official language has not been presented in satisfactory detail. The extent to which Albanian is spoken in some Greek homes, for instance, represents an aspect of the problem of language which has not yet been properly studied. The book however has no defect from which it could not be freed in a second edition, and it is to be hoped that Mr. Rundle will soon have this opportunity. M. A.

THE BASIS OF SOVIET STRENGTH. By GEORGE B. CRESSEY. *New York and London: McGraw-Hill Book Co.*, 1945. 8×5½ *inches;* xii+288 *pages; maps and illustrations.* $3

A writer in a recent book on the Soviet Union complained that there were "no real experts on Russia, but only varying degrees of ignorance." Professor G. B. Cressey, the well-known authority on Asia, has set out in this volume to examine the geographical foundations of Soviet achievement and has succeeded in producing an attractive, readable, and objective survey which should help to extend knowledge of this huge area. The author has drawn heavily upon a previous work of his on Asia and on other sources, and has made use of personal observation from three visits to the Union, the last in 1944. The rather uneven balance in the book may be due to the method of compilation.

An introductory chapter, which deals briefly with some geographical factors in relationship to historical and political development, is followed by a longer section on the U.S.S.R. in its Eurasian setting. This laudable design fails to achieve its purpose. The chapter is too condensed and technical for the general

reader and not detailed enough for the specialist. The introduction without explanation of such terms as "podsol" and "chernozem" and the use of Köppen's climatic nomenclature will be confusing to many.

Four chapters deal lucidly with Peoples, Physical Foundations, Mineral Wealth, and Industrialization, although the first of these might have been curtailed in favour of the second in which the geographic conditions are considered rather sketchily.

An excellent statement on the basic principles of regional geography introduces three chapters describing the twenty-four regions into which the Union has been divided. These are the weakest part of the book. Generally the treatment of each region is too brief to be adequate; important aspects are omitted or briefly mentioned. The significant economic and cultural development of southern Crimea is dismissed, for example, in six lines; the Moscow region receives considerable attention but without mention of the important Ivanova industrial district; the great phosphate deposits of the Kirov area and the chemical industry of Dzerzinsk pass unnoticed; the Volga basin as a whole is incompletely considered, as are the important experimentation and extension in the growth of orchard fruits. Through the stress of condensation, there reappears in this regional section the tendency to mention without explanation. The bald statement that the "most prominent vegetation is the bushy saxaul" means nothing to the general reader and unfairly dismisses a valuable plant of the dry Kazakhstan steppe.

The last chapter on "Geostrategy and the future of the Union" is in some respects the best in the book. After examining Mackinder's "Heartland" thesis and quoting other continental writers on "geopolitics," the author considers ten geographical elements and their political significance. He concludes that for the U.S.S.R. the peripheral areas are of greater importance than the "Heartland," and that peace and prosperity will rest on active cooperation in a world society.

The book is packed with accurate, generally up-to-date statistics, mostly of Soviet origin, and the author rightly deprecates the use of percentages alone for showing economic expansion. Discrepancies are few. The area under wheat in 1938 is correctly given as 102,546,500 acres on page 141, but the itemized figures on the previous page do not total this. Two hundred coal mines are said to be in operation in the Donets Basin, but the number becomes seven hundred two pages later.

The volume is embellished with a large number of excellent photographs, and some of the maps, especially those illustrating the general geographic features of the Union, are very good. There should be more maps to supplement the regional descriptions and one to show the disposition of the regions. An excellent, annotated bibliography and an adequate index add to the value of the book.

This is an ambitious work containing a useful summary of the geography of the Soviet Union; if complete success is missed it is through attempting to paint so extensive a scene on a canvas too restricted. D. W. S.

MANUEL GÉOGRAPHIQUE DE POLITIQUE EUROPÉENNE. Tome II, 1ère Partie, L'Europe Germanique et ses bornes. 2ème Partie, L'Allemagne. By JACQUES ANCEL. *Paris: Librairie Delgrave*, 1940, 1945. 10×6½ *inches; 253, 269 pages; illustrations and maps.* 36*s*

The economic and commercial aspects of the geography of Europe have loomed so large in modern text-books, and particularly those of British origin, that it is a relief to turn to the most recent work of Professor Ancel, the second tome of whose great work is now completed and available to us. More successfully than most of their contemporaries in other countries, the disciples of Vidal de la

Blache—of whom Jacques Ancel is one of the most distinguished—know how, in their interpretation of the human environment, to give proper emphasis to the less material aspects of human response to geographical possibilities. Their cultural heritage encourages them to think of the civilization with which they are concerned as more than a record of economic production and commerce. No recent foreign geographical work could be translated into English with greater advantage to the cause of geography in Britain.

Perhaps in the section of the work devoted to Switzerland the admirable method of regional analysis and synthesis is seen to its best advantage. The entirety of the second part of Tome I is devoted to Germany, while the first part finds space for the countries and provinces which border Germany on its western frontier. Lorraine however is not included, and it is difficult to appreciate why this is so in view of its inevitable association with Germany in respect of both the physical and humanistic aspects of its geography. It is perhaps the greatest merit of the work that it is dispassionate and objective: this despite the temptations which must have offered themselves to all French geographers at the time Professor Ancel was writing to allow at least suggestions of hostility to Germany to creep in.

The many sketch-maps are of great importance to the reader, enabling him to follow the intricacies of the regional analysis, whilst too comprehensive and over-generalized maps are rightly avoided. The bibliographies are drawn almost entirely from French geographical literature; and it is rather disturbing to our pride to discover no reference to any scientific paper in English from the fairly representative selection which might have been included. W. F.

ASIA

A PILGRIM IN ARABIA. By H. St J. B. PHILBY. *London: Robert Hale*, 1946 (*first published* 1943). $8\frac{1}{2} \times 3\frac{1}{2}$ *inches;* 198 *pages; illustrations.* 16*s*

The five studies which form the substance of Mr. Philby's latest book are too important to be described as sketches, or even "snapshots" as he calls them in his preface. Each of them, except perhaps the last, is almost an album in itself. They deal with Mecca and the pilgrimage, the visitation to Madina, a visit to Riyadh, an excursion to the Al Shifa district with an ascent of Mount Qarnait in the neighbourhood of Taif, and a holiday journey in Persia. The many readers who do not want to know precisely where they are will enjoy these studies unconditionally, but a general map, and especially sketch-maps for the last two, would have been a great help.

The Introduction might lead one to expect a good deal more of a political nature in the rest of the book than there is. In it Mr. Philby pays a tribute to that great desert statesman, Ibn Saud, and to the strength that he was to us in the bad days of the war. "But let us make no mistake about it. The Arabs are not happy about our policy or its implications." The trouble is, I suppose, that we are not only such good colonizers (in more than merely the old sense of settling and ruling out-of-the-way countries) but also such good schoolmasters. I doubt if any one of us now wants to own or rule the Middle East, and probably most Arabs would acquit us of such designs, but we know so much better than everybody else how their countries should be run, and are often ready to insist on compulsory education for a much longer period than even the young have to submit to.

Mr. Philby is not a schoolmaster, but he takes us on his pilgrimages in such a way that we thoroughly enjoy them and learn more than we should from conscious instruction. Since he is as at home in the Hijaz as in England, there is a

great difference between his account of the pilgrimage and those of previous European writers. The future aspirant to the honours of the Haj will want more instruction in details which are now second nature to Mr. Philby, but he will certainly need to read this book. In it the armchair pilgrim has all he needs, and will join in tribute to the sagacity which has so improved conditions that the risk of sickness or death has been greatly reduced without affecting the essentially individual character of the pilgrimage. Mr. Philby, as a domiciled Hijazi and a very privileged one, performed his pilgrimage and his visitation to Madina in a good deal more comfort than an experienced Arabian traveller will expect in ordinary circumstances, but, discounting that, there is many a lesson that comfort can quickly and easily be obtained by discarding the non-essentials with which we clutter up our existence in the west.

Quiet as the cities of the Hijaz may be in comparison with the cities of Europe, they are by Arabian standards noisy, crowded, and difficult, and it is with a sense of relaxation that we turn to the more intimate atmosphere Mr. Philby brings us in his description of Riyadh and its life. It was the summer of 1931 and Ibn Saud was fifty-one. Mr. Philby describes him as being no longer alone sufficient to the great task of administering his wide territories. He felt the want of trusty men to do his will, and inevitably as conditions became more stable problems of finance and economics arose with which by nature, training, and experience he was ill-fitted to deal. All this is not surprising; what is surprising is that fifteen years later such a man with such a burden still remains the outstanding statesman of the Middle East.

Mr. Philby on his excursion to Al Shiffa and ascent of Mount Qarnait not only describes an area unvisited by Europeans, but also gives a delightful account of a holiday trip taken almost on the spur of the moment and without any elaborate preparation. These are the two necessary conditions to the best holiday travel and the reader enjoys it as much as the author did. Admirable pictures of Qarnait show well the diadem effect which gives it its name. After climbing Qarnait Mr. Philby climbed the neighbouring height of Daka. He was the first European to climb either mountain and makes for the latter the tentative claim of being the highest point of the Hijaz, 8350 feet by his aneroid.

Mr. Philby's last study takes us to Persia in 1921, where he went from Iraq to spend a holiday. Crossing the frontier at Qasr-i-Shirin he went by Kirmanshah (where he spent ten days), Bisitim, Kangavar, where he was the recipient of delightful hospitality from the governor, Hamadan, where he stayed with a charming Jewish host and climbed the 11,000-foot mountain to Alwand, and Qazwin to Teheran. Thence he returned by a slightly different route to Baghdad. In the course of this trip he met and talked to all sorts and conditions of men. It was the moment when foreign intervention in Persia had come to an end and it is interesting to read Mr. Philby's high hopes for an independent Persia in the light of the events of the quarter of a century which has elapsed since his visit, and particularly of the last few years. One may be forgiven for doubting whether, even if the lion leaves the prey (to use Mr. Philby's analogy), the bear is prepared to do likewise. And Persia, alas, seems to have fewer sons than her Arab neighbours sufficiently single minded, public spirited, and honest to unite her and build her into a country which can hold its own in this world. I do not myself believe that there is any race on earth that cannot learn to exercise the essential freedoms that are the right of every human and every nation, and a country with the culture and civilization of Persia is far from being a hopeless case. It seems evident however that she is in sore need of disinterested help: whether she will be allowed to have it is another question. W. H. I.

THE PHILIPPINE ISLANDS. By W. CAMERON FORBES. (Revised edition.) *Cambridge, Mass.: Harvard University Press*, 1945. 8½×6 *inches;* 412 *pages; illustrations and maps.* 28*s*

This work describes the political, social, and economic history of the Philippine Islands, principally since their occupation by the Americans at the end of last century. It is an abridged and revised version of the same author's two-volume edition of 'The Philippine Islands,' published by the Harvard University Press in 1928. The author was Governor-General of the Philippines from 1909 to 1913.

In the first chapter, Mr. Forbes gives a somewhat loosely written geographical survey of the Philippines, referring briefly to their physical features, climate, distribution of population, and economic resources. This is followed by a short chapter on the history of the islands up to the outbreak of the Spanish-American War in 1898; tribute is paid to Spain's achievements in colonization. The remainder of the book presents a detailed historical account of the American occupation and government, separate chapters being devoted to the growth of civil government, public order, health and education, and public works. But these chapters describe conditions only up to about 1928; none of the many interesting statistical tables has been brought up to date. The story of the Philippine independence movement however is fully told up to the outbreak of the war with Japan in 1941. The concluding chapter summarizes American achievements in the government and development of the Philippine Islands.

The work is well produced and is illustrated by a number of good photographs. It should long remain a standard source-book on the history of the Philippine Islands. J. C. S.

MALAY FISHERMEN: their peasant economy. By RAYMOND FIRTH. *London: Kegan Paul, Trench, Trubner*, 1946. 8½×5½ *inches;* xii+354 *pages; illustrations, diagrams, and maps.* 25*s*

This book is an admirable example of what can be achieved by the application of anthropological technique to the economic relations of a small society and its environment; without this approach it might have been descriptive in the vague and superficial sense. The detailed examination of the routine of life in a small corner of Kelantan fills the bulk of the book, and the pages which deal with fundamentals of category and method are few but greatly to the point.

The equation of a fishing society with a peasantry gives a slight but salutary shock; the discussion of the point (pages 22–7) raises the important question of whether economic principles developed in western society can usefully be applied to eastern communities. Professor Firth's conclusions are very well balanced, avoiding both the impatient simplification which regards oriental religious and social values as a mere veneer, and the opposite (and fundamentally reactionary) denial that any really valid comparisons between East and West are possible. His position is fully supported; for instance, by the analysis of the mobilization of credit by giving a feast to which the guests bring presents (pages 176–82): the host usually makes a profit, but incurs reciprocal future liabilities, and the long-term balance sheet is keenly appreciated by both host and guests. Appendix I, "Note on problems and technique," is more than a useful contribution to method. Whether the actual equation is proved however is another matter. Certainly few oriental peasant economies can be self-financing to the extent described here, and one could wish for more attention to a serious divergence from the oriental peasant norm: the relatively even spacing of current income over ten months of the year (page 293), with the consequent avoidance of really serious debt and bondage to the middleman.

The directly geographical material in the book is limited, and some readers may find the mass of detail on organization, finance, and marketing rather wearisome, despite the aid of graphs such as that showing the sequence of bargaining in various situations (page 202). One hardly knows which to admire more, Professor Firth's skill and pertinacity in tracking down and presenting details of scores of catches and hagglings, or the remarkable ingenuity of the fishermen's methods of sharing the day-to-day takings; it is no small achievement to have unravelled their underlying general principles. Professor Firth was less than a year in Malaya, but his remarks on "Malay laziness" (page 82) and his general understanding are an ample demonstration that it is intensity of trained observation, and not the casual noticings of "hard-headed men who've known the East for years," that really counts.

Direct geographical description is not after all the object of the book, and enough has been said to show that, with Mrs. Firth's complementary 'Housekeeping among Malay peasants,' it deserves the attention of all interested in the human geography of primary producers. Geographical sidelights occur throughout, on trade with Siam and the offshore islands for instance, or the incidental remark that two hundred and fifty coconuts a year are enough for the consumption of a family of six (page 285). There are recurrent geographical motifs—the beaches and the sea, the day's weather and the rhythm of the monsoon—their influence traced for us right down to the bargaining for a few dollars and cents on Perupok beach. O. H. K. S.

TIBETAN WORD BOOK. 10×7 *inches;* xvi+448 *pages.* 30*s*

TIBETAN SYLLABLES. 7×5 *inches;* x+120 *pages.* 4*s* 6*d*

TIBETAN SENTENCES. 7×5 *inches;* vi+138 *pages.* 4*s* 6*d*

By Sir Basil Gould and Hugh Edward Richardson. *Calcutta: Oxford University Press,* 1943

It is always an event when a new work on spoken Tibetan makes its appearance, and the publication of these volumes is no exception; at the same time it is possible to extend a most particular welcome to these latest additions to our hitherto scanty resources by reason of the skill shown by the two authors in their handling of the material, which has been arranged throughout in a manner well calculated to help students both elementary and more advanced.

Of the three books, by far the most important is the 'Tibetan word book.' What makes it particularly useful is the fact that the classification of the words is consistently based upon the primitive sense of the various roots, round which all secondary meanings, as well as derivatives formed conjointly with other roots, are grouped in logical order. This method provides the key to the proper understanding of any Tibetan word; merely to be given an English equivalent does not really explain how the Tibetan word is to be used, and it is only by having a clear grasp of the first meaning of the root or roots that one can use the more remote derivatives intelligently. If this is true of every language to some extent, it is far more true of Tibetan, in which the intrinsic power of the monosyllabic root (if one may put it so) has been far less impaired by use than in the much inflected languages of the European family; in these, moreover, the excessive development of metaphor has played havoc with many of the fundamental notions that words are intended to express.

It would be invidious to search for points of criticism in such sound compilations as these; two points are however worth mentioning, if only because the authors might bear them in mind in any further editions. The first point concerns a question of phonetics, namely, the various consonants with *r* subscript,

such as *kr*, *khr*, *br*, etc., and their romanized equivalents. In these books the precedent set by Sir Charles Bell has been followed in suggesting that the *r* sound is to be pronounced. Other scholars, such as Jäschke, hold that the *r* is not usually pronounced as such (there are some admitted exceptions), but that its presence merely modifies the other consonant to which it is attached in the sense of causing it to be pronounced like one of the Hindu "cerebrals," in sounding which the tongue has to be pressed hard against the palate so as to produce a slightly explosive effect; according to that view the three examples given above would be romanized as ṭ, ṭh, and ḍ respectively. The reviewer feels bound to say that his own ear, when listening to Tibetans, has invariably borne out the second view. For example, the common word spelt *gral-sgrig*, meaning "ready," should, according to the one opinion, be pronounced as *tra-dri*, and that is how it is given in many books; but the reviewer, who has used that word as a test case, has always heard it as *t'a(n)-di(g)*, the *n* being inserted for euphony but not written. Incidentally, the introduction of unwritten consonant sounds in order to satisfy the demands of the Tibetan ear (such as the *n* mentioned above) is such a frequent practice that it would seem important to indicate it somehow when romanizing Tibetan words; otherwise a stranger will certainly utter what is, to the native ear, a cacophony.

The second point calling for mention affects the translation of terms of metaphysical import, in which Tibetan is particularly rich. Many such words are in general use, which is not surprising when one remembers that in Tibet people of all classes show a continual interest in whatever concerns the spiritual life, so that a real command of the language should by rights include a knowledge of the chief technical terms in common use, for some of which it is by no means easy to find exact equivalents in any modern European tongue. For example, it is open to question whether our word "religion" adequately renders the Tibetan *ch'hō(s)*, so divergent are the conceptions to which these two words respectively correspond: *ch'hō(s)*, which is the equivalent of the Sanskrit *dharma*, would be better rendered by our rare word "norm," with "doctrine" as a secondary meaning and "religion" making at best a doubtful third. When it comes to still more technical terms, the dangers of mistranslation are all the greater: to give one instance, *wang kur-wa* (spelt *dbang skur-ba*) has been translated "to give blessing," whereas it actually refers to the conferring of an initiation (literally it means "to bestow a power"), which is a very different thing; in a few contexts "ordination" might be a possible rendering, but even that is doubtful.

The appearance of the books is most attractive as regards both the form of the Tibetan characters (models of their kind) and the general lay-out. No one intending to visit the Tibetan countries or otherwise interested in the language can afford to be without them. M. P.

PLANT-HUNTING IN CHINA: a history of botanical exploration in China and the Tibetan marches. By E. H. M. Cox. *London: Collins*, 1945. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 230 pages; illustrations and sketch-maps.* 12*s* 6*d*

This is a delightful book. It will appeal not only to gardeners and to anyone who is interested in China, but also to the general reader, for there are many fascinating stories of travel and discovery within its pages. The business of hunting in the wilder parts of China for plants to be grown in English gardens has engaged many men for well over a century. The hunters have been people from every walk of life: captains of sailing ships and consular officers, medical men and missionaries, renowned geographers and professional collectors. One thing they seem to have had in common was that they were gentle and they were brave. Gentleness was the key to successful travel among people predis-

posed to be hostile to strangers; bravery certainly was needed—of the plant hunters mentioned in this book, more than a dozen died in the field, some from disease, some by violence. More than one collector was murdered because he tried to save his collection instead of going while the going was good.

The story of plant hunting in China can hardly be summarized in a brief review. A few florists' curiosities were shipped home in the eighteenth century and more garden flowers in the early nineteenth, but the story really begins with the collection by professional botanists of wild flowering species capable of introduction into English gardens. The first of the great collectors was that remarkable traveller Robert Fortune, who returned to England from his first expedition just a century ago. The climax was reached with the professionals of the present century: Wilson, Forrest, Farrar, Kingdon Ward, and Rock. For further particulars, reference must be made to the book itself, which gives brief biographies of the collectors, outlines their travels, quotes from their writings, and provides useful sketch-maps of the territories they explored.

The author has disentangled a complex subject with considerable skill, and the book is well put together. It has the added recommendation that it will lead the interested reader to the original writings of the collectors themselves. These vary pleasantly in style and in emphasis, and apart from botanical matters they provide a lively picture of the Chinese people and their ways over a century. Anyone who knows present-day China will find a somewhat unholy pleasure in reading what Fortune thought of the country a hundred years ago. The illustrations deserve especial praise. They are mostly whole-page photographs taken by the collectors, and those of Wilson, in particular, are masterpieces of scenic photography. He always burdened himself with a whole-plate camera and the result was a crispness of detail, particularly in the distant scene, which is rare to-day.

For the general reader then, the book is to be recommended; but from the geographer's point of view it is open to criticism. In romanizing Chinese names the author has thrown system to the winds, with the excuse that he has followed the forms which would be best known to readers of the botanical literature. This at least adds the charm of variety and unexpectedness to the journeys described, even if it makes them harder to follow. Chapter I is a geographical outline of China, very necessary for readers who may wish to form an idea of the greatly differing conditions, particularly as to climate, under which plants introduced to England occur naturally in China. The broad picture is well drawn, but there are many inaccuracies of detail—too many to list here. Anyone who is making a critical study of plant geography—of such matters as the relation of individual plants to particular kinds of soil, rock, or climate—should therefore not rely on this chapter, but should refer to more specialized sources of information.

One point of perennial interest to gardeners, about which a good deal is said in the book, may be mentioned here: namely, the relationship of rhododendrons to limestone. Doubtless, as Forrest insisted, wild rhododendrons may occur in limestone country with their roots among the rock; but very frequently, in the high-rainfall areas which rhododendrons prefer, acid residual soils will be found directly over limestone itself. In an area mentioned by Cox, of which the reviewer has special knowledge (the Omeishan–Washan–Wawushan triangle in Szechwan), it is true that the great cliffs bounding these mountains are of limestone, but the flatter surfaces on which plants grow are often of other rocks. The lower slopes of the mountains are mostly weathered sandstones and shales, while the peaks are capped with several hundred feet of basalt, to which doubtless they owe their resistance to denudation. There is quite a deep, sedentary soil over the basalt, and samples which the reviewer collected on Omeishan, near the

summit, were strongly acid (pH 4·7–5·0). Cox's discussion of the occurrence of rhododendrons in this area (pp. 144–45) should be read with the foregoing facts in mind. Again, it is misleading to say (as on p. 26 and elsewhere) that Szechwan is not influenced by the monsoon. The whole of China has a monsoonal type of climate, and Szechwan like the rest of the country has wet summers and dry winters. However the dryness of the Szechwan winter is somewhat alleviated by a generally cloudy sky and a humid atmosphere, in which respect it differs from Yunnan and the north-west of China. H. L. R.

AFRICA

SUDAN GEOGRAPHY. By R. A. HODGKIN. *Khartoum: Education Department of the Sudan Government*, 1946. 9½×6½ *inches; 160 pages; diagrams, sketch-maps, and maps*

The author of this book, whose price is not stated, is Lecturer in Geography at Gordon College, Khartoum, and the book is intended mainly for use in the first two years of Sudan secondary schools. If the pupils who will use it are of the same age and attainments as those in the first two years of English secondary schools, they will find the text rather advanced. The book is published by the Education Department of the Sudan Government and has been produced in the Sudan. The department is to be congratulated upon the venture and, if this has not already been done, it might consider supplementing the book by a simple, well-illustrated, descriptive Geography for primary schools, and a more advanced text for teachers and teachers in training. It is hoped that improvements will be possible in the printing as well as in the production of maps and diagrams, and that a number of photographs of important features will be included.

The plan of the book is excellent. It begins with Khartoum and Omdurman and then proceeds to an examination of the different geographical regions, introducing aspects of the physical basis where most appropriate and stressing very effectively at all stages the life and work of the inhabitants and how these are influenced by environment. The final chapter is entitled "The Nile and the Sudan," and it is a pity that under this heading more is not done to pull together the main threads of the previous excellent fourteen chapters so that the pupils are given a clear picture of the country as a whole.

There are very useful exercises at the end of each chapter, five valuable appendices, and an interesting glossary for non-Sudanese readers. L. B.

NORTH AMERICA

NEWFOUNDLAND: a study of settlement, with maps and illustrations. By GRIFFITH TAYLOR. *Toronto: Canadian Institute of International Affairs*, 1946. 10×6½ *inches; 34 pages; illustrations and sketch-maps.* $1.00

The first part of this book consists of summaries of the geology, landforms, climate, settlement, and history of Newfoundland; then follows a series of short essays dealing with the areas visited by the author in the summer of 1945. The concentration of population along the coast is explained by the dominance of fishing in the island's economy combined with the traditional lack of interest in agriculture. The interior—tundra where above 1200 feet—offers little prospect of successful farming and is partly allocated to the paper-making combines, though mineral reserves, as yet unexplored in places, may attract settlers. This book shows the social value of a "traverse" survey which, though rapid, is based on a series of places characteristic of many more and used as type specimens.

The illustrations include thirty photographs, some over-reduced but all interesting, and fifteen characteristic diagrams that are "unpretending" (to quote Baedeker) and yet reveal how a place looks. The block diagram of St. John's for example, shows us a town on a hillside with main streets parallel to the waterfront and roads climbing steeply to the suburbs; in the text we are told where the shops and the dominating public buildings are to be found, and the houses are assessed in four categories; incidentally the author finds the absence of the "checkerboard plan" a welcome change from American cities. Newfoundland offers a fascinating field of inquiry, and the reviewer hopes that this investigation will be the forerunner of others which will provide useful material on an island whose recent history has been marked by severe economic problems.

T. W. F.

THE ROAD OF A NATURALIST. By DONALD CULROSS PEATTIE. *London: Robert Hale*, 1946. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 220 pages; woodcut illustrations.* 12*s* 6*d*

Mr. Peattie's book consists of autobiographical fragments, mixed with odd scraps of information about the natural history of the United States, and paragraphs on the history of the exploration of the North American continent. He re-tells the story of the pollination of the Joshua tree by the moth *Pronuba*, which lays its eggs among the ovules of the flowers. Then there is a story of a plague of locusts in Utah which was checked by seagulls who gobbled up the locusts, so that the grateful citizens of Salt Lake City put up a memorial to a seagull. The deliberate introduction of the House Sparrow into the United States in 1857 makes less pleasant reading, as does the extermination of the once abundant sea otters by the Russian fur traders of Alaska. It is surprising that so many of the earlier explorers were primarily botanists, whose search for plants led them into the unexplored west. The few pages allowed to David Douglas, whose name has been made familiar by the Douglas Fir, tell a story of perseverance under extremely hard conditions in what is now the State of Washington.

This book should make pleasant nostalgic reading for those who have visited the waste places of North America, and bring back to them the trees and flowers of that vast country. The author's methods of study and his use of a scientific library to aid his field observations are also to be commended. A. H. G. A.

SOUTH AMERICA

LATIN AMERICA. Countrysides and united regions. By ROBERT S. PLATT. *London: McGraw-Hill*, 1943. $8\frac{1}{2} \times 6$ *inches;* x+564 *pages; maps and illustrations.* 25*s*

The author's approach to the twenty Republics and sixteen Colonies of Latin America—for he includes the Caribbean Islands—is described as a collection of field studies set in a framework of complex generalizations. The generalizations are certainly many-sided. They include political divisions, land-forms (highlands or lowlands), climate, vegetation, soils, and population. Viewing all these factors as if through a single lens, Professor Platt presents us with a composite picture that certainly strikes some unfamiliar notes.

Thus we are confronted with a bracketed Argentina-Chile, with the disarming aside that "They are about as much alike as California and Texas, and about as different." The reasons given for their similarity are that their dominating white populations lie in equal-latitude, lowland plains; that they share the southern extremity of South America; that neither has any native Indian or negro problems; and that they are divided from each other throughout by the

Andes, in distinction from the other Pacific Coast Republics which include whole sectors of the Cordillera within their boundaries. For the most part the bracketing of countries (the term "country" implies autonomous statehood) derives some familiarity from early political origins. Thus we have Venezuela-Colombia, the West Indies, all Central America, all Brazil, and Mexico. Incidentally, two historical maps (pp. 520–21), showing European apportionment of the new lands between Spain and Portugal in the sixteenth century compared with the political organizations that had grown up on the spot two centuries later, are well worth study.

All this is introductory to the main theme, which is the selection of certain "core zones" and "sub-zones." These are demonstrated by "traverses" along which are plotted "field studies." They are the "close-ups" that give us a working picture of the life and outlook of the communities or individuals therein. The aim is to present a true cross-section, based on a uniform and objective pattern of each country and colony in Latin America—a truly formidable task. There are no fewer than seventy-five detailed "field studies" in the twenty countries (excluding Colonies) named. This field work has been carried on for some portion of each year over nearly twenty years. Full recognition must be given to the work of accumulating, sorting, and discarding the vast quantity of factual material that such a range of territory must have offered before the final pattern could be decided upon.

This pattern is striking. First to be decided on is the "core zone"; that is, the sector of any country which by reason of population, climate, productivity, etc., dominates all its other parts, called sub-zones. Field studies in both core and sub-zone then illustrate and emphasize their relative status. In Mexico, for instance, the core-zone is the Central Plateau, where we are introduced to a small farm and a large hacienda. This is followed by field studies of a silver mine, an estate in the north-west hill country, farms on the Pacific lowlands and in Lower California, and henequen estates for sisal or pulque in Yucatan. Lastly the detailed zone and field studies are summarized by reasoned judgments, based on the facts presented. Thus, of the humid Pampa, core-zone of Argentina, we read: "An extensive plain unique in its combination of unbroken fertility, mild climate and coastal accessibility . . . covered with a railroad network focusing exports, spread over an area of level grassland, without valleys, floods or snow." Alfalfa (lucerne) is rightly stressed as the "pivotal" crop in Pampa productivity. Again, of Brazil: "It is the whole of Portuguese America, with one half the area and nearly half the population of South America. No other autonomous territory . . . is so rich in potentialities either to produce commodities, or support population." And of Uruguay: "All other South American countries suffer by a formal comparison with this smallest of all the States. Uruguay has a greater 'per capita' commerce, a greater proportion of land used productively, a more compact system of land transport and a higher proportion of white population than any other . . . because it has no unproductive outlying (*i.e.* sub-zone) regions to be averaged with the core-zone." In other words, Uruguay is all "core."

From these field studies emerge at times interesting and little-known data. The study conducted on the Mariel Sugar Estate, on the north shore of Cuba, shows that the ground-plan of the estate presents certain curious crescent segments. These are the survivals of grazing-rights granted to the early soldier-colonists, whose fixed abode at any centre was given a radius of so many miles. It recalls the early jerked beef, or "boucan" industry, which flourished for over a century and is perpetuated by the name "bucaneer." Such grazing rights were of course quite distinct from the freehold estates and from the grants of Indian

"encomiendas." A second instance is the field studies of Fordlandia and Belterra, the 2,000,000-acre concession taken up twenty-five years ago by the Ford Motor Company on the lower Tapajos river, close to Para, with the object of becoming self-supporting in native rubber. To date, some 23,000 acres have been cleared and planted, of which about 8000 are in full bearing. Professor Platt hazards that, if fully exploited, "these concessions might conceivably supply all the rubber needed in the world." A visit to still more extensive estates in the Far East, where rubber planting has been in active progress for over half a century, might modify his views.

The chief interest of this field study however lies in its account, not of the Ford rubber growing, but of the lumbering operations undertaken to clear this rainy tropic forest for planting. The Tapajos forest contains a mixed stand of broad-leaved hardwoods, averaging 100 feet of straight trunk to the forest crown and about 3 feet diameter. They stand in a not too dense undergrowth, with "ceiba" and occasional soft-woods, festooned with lianas and wild fig. The undergrowth and soft woods have small commercial value; the quality of the hardwoods is very high. Yet at Belterra their very variety made it impossible to assemble and keep moving sufficient supplies of each species to enable it to be popularized, so as to create a steady demand from lumber merchants in the foreign market. So the Ford sawmills have for some time been closed, save for local requirements. The Amazon Valley presents the greatest single area of tropic rain-forest in the world; it joins hands with similar forests that thrust northward towards it along the valleys of the Upper Parana; for 1500 miles south of Bahia port a like rainy forest faces Brazil's Atlantic lowlands; are we then to conclude that the only means of dealing with this unrivalled source of cellulose is to send it up in smoke?

There is a useful glossary which not only explains the Spanish-English equivalents of common words, but extends to scientific terms. The volume is profusely illustrated; nearly all its 550 pages carry a photo, plan, or map. The maps have evidently been reduced from a much larger scale, and it is difficult to distinguish the symbols without a good reading-glass.

Designed to fill the gaps in his university library, Professor Platt's work can be profitably studied by visitors to Latin America as well as by students. While its viewpoint is basically economic, it aims at presenting the conditions under which the working communities of these countries, outside the Government or official class, make their living and live with each other. Looked at from this angle, we are all economists. W. S. B.

PHYSICAL GEOGRAPHY

KLIMAAT: klimaattypen, klimaatgebieden, bodenproduktie, bewolking. By W. E. Boerman. [Noorduijn's Wetenschappelijke Reeks. No. 25.] *Gorinchem: Noorduijn en Zoon N.V.*, 1946. 7×5 *inches;* viii+235 *pages; maps and diagrams*

This book is an introduction to climatology, chiefly from the economic standpoint. After a cursory exploration of general principles, there follows a regional account of world climates comprising in each section useful tables for various places of mean annual temperature, mean temperature of the warmest and coldest months, mean annual rainfall with mean rainfall of the wettest and driest months. The account, on the whole well rendered, is perhaps a little meagre and there is no reference to thunderstorms, a striking aspect of the climate of many countries. A somewhat serious error, both of theory and of fact, occurs on p. 84 where it is stated that because the level of the average isotherm of 0° C.

(32° F.) of the warmest month—July—lies at about 12,000 feet over the Pyrenees that chain does not reach the level of perpetual snow. Apart from the actual presence in the Pyrenees of glaciers at or below 10,000 feet, it is known that permanent snow can, and often does, withstand a mean July temperature a few degrees above the freezing-point. The statement that the Thames is practically never frozen is hardly true of the upper reaches of the river which do freeze for short spells in quite a number of winters.

The reader will not have gone very far without being confronted with Köppen's celebrated scheme of climatic classification, into whose rigid framework the entire text and set of maps is fitted. The reader might almost be excused for thinking that the book was written less with the purpose of illustrating climate with the help of the classification than of giving the classification itself an exercise. This seems unwise procedure, more likely to repel than attract students to the study of climate. The application of such devices to the highly complex and variable physical conditions which make up climate is unnecessary if not actually misleading.

Towards the end of the volume the distribution of agricultural commodities and of population density is indicated in relation to Köppen's main climatic types with their divisions and subdivisions; namely A, Tropical Rain Climates; B, Dry Climates; C, Warm Temperate Rain Climates; D, Boreal Forest Climates; E, Snow Climates. According to a table on p. 225, of the total number of cities in the world having more than one hundred thousand inhabitants, 7·9 per cent. are in type A, 5·8 in B, 68·4 in C, and 18 in D; and of the 68·4 per cent. in C 54·2 belong to the Cf division with frequent precipitation at all seasons. Most of the British Isles at the lower levels are coded Cfb, the letter b signifying at least four months with a mean temperature over 10° C. (50° F.) and the warmest month cooler than 22° C. (72° F.). But the Scottish Highlands are shown to rise into the ETH climatic division denoting the elevated Snow Tundra region. The fact, incidentally, that conditions in these islands rapidly become rigorous with elevation of the ground reflects the general unsuitability of Köppen's broad designation "Warm Temperate" for the cool damp region of North-Western Europe. But there is no designation "Cool Temperate" in his scheme, the nearest approach being the Boreal climate D which, occupying most of North America, Eastern Europe, and Asia, differs essentially from C in having a mean temperature for the coldest month below −3° C. (27° F.), judged by Köppen to be the highest compatible with a regular as distinct from occasional winter snowfall.

In relation to forest trees, Köppen calls the C-division beech climate and the D-division oak climate. This can only mean that D is not very favourable to beech, not that C is unfavourable to oak, since England, France, Germany, and other C-countries of Western and Central Europe are preeminently oak-lands.

L. C. W. B.

MATHEMATICAL GEOGRAPHY

MAP PROJECTIONS. By G. P. Kellaway. *London: Methuen*, 1946. 8½×5½ *inches;* viii+128 *pages; diagrams.* 10*s* 6*d*

This neat, slim, and very useful book of less than one hundred and fifty pages covers a great deal of ground and covers it very thoroughly, though dealing only with the elements of the subject and using a minimum of mathematics. It is clearly the work of a teacher: one who knows better than to slur over even the most elementary difficulties and who has the patience—I think this quality is largely responsible for the merits of the book—to set it all down so that the student who wants to get to the bottom of it should not fail.

The projections dealt with are many—possibly too many, for several of them, such as the Zenithal Perspective "Approximate Equal-Area" and "Approximate Equidistant," are hardly practical propositions, while neither the Plate-Carrée nor Lambert's Cylindrical Equal-Area are really worth a page and a half each. In the latter case, by the way, I think it is a pity that this unimportant projection should be described in the chapter index as "Lambert's Equal-Area," a title commonly used for his popular Zenithal Equatorial Equal-Area, to which the writer does not attach the name of Lambert at all. But the inclusion even of projections which have little or no application can at least help the student to realize better the problem which the cartographer has to face. We have detailed treatment of Zenithals (Perspective and Non-Perspective), Gnomonic, Stereographic, Orthographic, Equidistant, and Equal-Area (Polar, Equatorial, and Oblique)—almost the full range, treated in detail in almost every case and with useful notes on the transformations from one to the other. The Cylindricals include the Simple Perspective, Plate Carrée, Cassini's, Gall's, Mercator's (and the Transverse form), and Lambert's Equal-Area. The Conics include the Perspective, "Simple," "Two-Standard," and One- and Two-Standard Equal-Area and Orthomorphic, the Polyconic, the "International Map," and Bonne's. Lastly there are the conventional projections of Sanson-Flamsteed, Mollweide, and Aitoff, the first two of these also in their "re-centred" forms.

In each case the projection is introduced by a careful explanation of its relation to the "generating globe," or, in the case of a non-perspective projection, by the principle which it is intended to involve. Here the mathematics of the projection are gone into in detail so far as is necessary to determine the distances of parallels from the equator and the latitude and longitude scales at any point. Some simple but useful tables are given in many cases to show how the projected distances compare with the true. Then follow three paragraphs: "Summary of properties," "Limitations," and lastly a note on "Construction." The plan is admirable, though a certain amount of repetition is unavoidable, and the quicker and more intelligent reader will no doubt "skip." In the cases of the Equatorial and Oblique Zenithals, the properties have already been dealt with for the Polars, and the treatment consists largely of mathematics. This—especially the treatment of the Obliques—is perhaps the best part of the book, for it is no easy matter to explain in detail on paper. It is carefully and lucidly done, with the mathematics presented about as simply as could be, and with the help of some very adequate diagrams the serious student should not find the difficulties too great. An interesting feature of the treatment is that in almost every case the work on the method of projection culminates in a graticule drawn for a whole hemisphere or for the globe as the case may be, showing also the radius of the "generating globe" for that drawing.

As to mathematics, "a good working knowledge of the basic principles of elementary plane trigonometry" is all that the writer asks for and all that he uses. In a few cases—for example, in the absence of a solution to the equation for the distances of the parallels in Mollweide's projection—he shows how a graph may be drawn from which they can be obtained, while the more advanced work involved in the same process for the Orthomorphics (Mercator and the One- and Two-Standard Conics) is wisely summarized in the form "it can be shown that." For the student whose mathematics are slender, three appendices deal respectively with the trig. ratios and a few identities (I am not sure if the writer uses all that he includes); with circular measure, where I think he would have been wise to state more explicitly the most important fact that $arc = r\theta^c$, while there is space for a reminder that for small values of θ^c, $\tan \theta^c$ is a very close approximation to θ^c—a fact which is used without warning on p. 15; and

with the areas of zones of a sphere, where the student may be puzzled unless he realizes that the equality of zones of the sphere and belts of the cylinder belongs to the "it can be shown" class. There is also a fourth appendix on the simple properties and drawing of the ellipse.

The arrangement is not ideal, but apparently Part I is designed to cover the requirements of certain examinations, such as the Higher School Certificate, and Part II is included separately in order to complete the subject. Thus the Sanson-Flamsteed and Mollweide appear in Part I, but Aitoff cannot then appear as it is based on the Zenithal Equatorial Equal-Area which does not appear until Part II. It seems a pity that the "re-centred" (I prefer the term "interrupted") Sanson-Flamsteed and Mollweide should not have found places with the projections from which they are derived: the device has come to stay and involves no fresh or difficult principle; moreover it so strikingly answers some of the objections raised in the paragraphs on the "limitations" of these projections. Part III consists of a chapter on the "choice of a projection for a specific purpose." This subject is treated with the same thoroughness as the rest of the book, though I venture to suggest that it is the least satisfactory part of it. There really is less choice than the writer offers. No one would seriously propose the Cylindrical Equal-Area for a world map, even if its purpose is to show the distribution of tropical products, while the same projection would more than "probably be ruled out" for a map showing the products of the temperate zones; Gall's, which is actually largely used for such a purpose, is not mentioned. The advice however is all sound, though the reader may possibly still be in doubt which projection to use in any given case.

The book ends with a useful selection of thirty questions, progressively arranged, from the higher grade examinations of leading Universities. H. P.

HISTORY OF AIR NAVIGATION. By ARTHUR J. HUGHES. *London: Allen and Unwin*, 1946. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 154 pages; illustrations and maps.* 10*s* 6*d*

It is time that a history of air navigation should be written, and no one could be better qualified than the author of this book who has lived and worked among both the instruments of navigation and their users throughout the past quarter of a century. Much of the book makes fascinating reading; in particular, accounts of some of the famous early flights, such as Sir John Alcock's crossing of the Atlantic in 1919 and Francis Chichester's flight from New Zealand to Australia in 1931.

So far as the tools of the trade are concerned, compasses are dealt with fully, as indeed they should be in a work of this nature: they are likely to remain the basic navigation instrument. Sextants have much space devoted to them, which no doubt from the historical point of view is justified, but one is tempted to wonder whether their significance in the future will be quite what the author implies. Unless both the taking of sights and their reduction to positions are made automatic, increased cruising speeds will not allow sufficient time for the somewhat laborious astro-navigation technique as we know it to-day, bearing in mind the much more convenient radio and radar aids now available. Radio and radar aids themselves, which have contributed so much to navigation in the past few years, are not dealt with as fully as one would like, but no doubt the author, who apparently completed this work at the end of 1944, felt inhibited by the security regulations then in existence.

The book contains so much that is good that it is perhaps ungenerous to find fault, but it tends to suffer from being rather a series of unrelated facts than a story with continuity which many would find more readable, while some explanations, for example, of the Marc St. Hilaire method and Northerly turn-

ing error, may not be readily intelligible to the uninitiated. Nevertheless the author is to be congratulated on a valiant and worthwhile effort. Arthur Hughes is the first in this new field and must be accorded the credit that a pioneer deserves.

J. S. B.

MILITARY MAPS AND AIR PHOTOGRAPHS. Their use and interpretation. By A. K. LOBECK and W. J. TELLINGTON. *New York and London: McGraw-Hill*, 1944. 11½×9 *inches; x+250 pages; maps, diagrams, and illustrations*

The function of the printed word in the teaching of an essentially outdoor subject such as the use of maps must be largely a matter of personal opinion, closely linked with the method of practical instruction to be adopted. In this book the authors aim at confronting the reader, assumed to possess common sense and good judgment, "with an imposing array of actual problems which, if attacked earnestly, will provide the experience necessary for the development of a high degree of proficiency in the art of map reading and map interpretation." From this it seems clear that the authors' method contemplates a complete divorcement of practical work and academic book work. Many who have experience of instructing in this subject may well have serious doubts of the wisdom and efficiency of such a course.

Within the limits imposed by the method selected, the book is admirable and there can be no doubt that the authors have fully achieved their aim. The subject is dealt with in three separate divisions: map reading, landscape types, and air photographs. Each section contains its own array of actual problems. Each group of problems is prefaced by a particularly lucid explanation of the branch of the subject under discussion followed by demonstrations on carefully selected and excellently reproduced illustrations. The problems themselves are well chosen to cover the subject and to ensure a thorough grasp of the principles involved.

Although no reference is made to the use of the centesimal system of angular measure for latitudes and longitudes, to meridians (*e.g.* Paris) other than Greenwich as the origin of longitude, or to the nautical mile as a convenient unit for map reference systems, the basis of mapping and map use is well covered in Part I—Basic Map Reading, Part II—Elementary Problems and Methods, Part III—Topographic Forms, Part IV—Advanced Map Reading (pp. 1–90).

Throughout the book the authors use the word "topography" in place of "relief" on the grounds that "by common consent, topography has to do with the vertical rather than with the horizontal aspects of the map." This is regrettable and it is to be hoped that their example will not be followed. Part III, which deals with the representation of relief, rightly occupies a full half of the space allotted to map reading. Although there is no definition of a contour, the diagrams are sufficiently clear to permit the commonsense reader to infer an accurate definition.

Part VI (pp. 199–234), on Air Photographs, is limited to the fundamentals of photo reading. These are effectively stated although overcompression may tend to mislead, as for instance in the bald statement (p. 206) that a vertical air photograph should be held with the shadows towards the observer. If the illustrations (pp. 206 and 207) of this are examined at a desk with normal lighting from the left-hand side, the effect is the reverse of that intended; in Fig. A, which is intended to give the effect of inverted relief, the shadows lie to the right as well as beyond the objects, and thus give the effect of natural relief.

Part V (pp. 91–198) deals with Landscape Types in two sections on Constructional Forms and Destructional Forms. The devotion of so much space to this

subject is justified by the authors as teaching "map interpretation"; whilst a reference to the military problems (p. 238) seems to indicate that a soldier is expected to use such map interpretation to infer conditions, such as probability of water supply or nature of soil and type of surface, which could be more easily and more positively determined by normal intelligence methods. Surely this is carrying map mania too far. However that may be, this part is the most absorbing portion of the book.

The illustrations are extensive, appropriate, and clear, and their selection must have been the result of lengthy study. The working out of the set problems will provide a great deal of interest and occupation, and their satisfactory solution will be the achievement of the highest standard of academic map interpretation. D. R. C.

HISTORICAL GEOGRAPHY

THE SUMA ORIENTAL OF TOMÉ PIRES 1512–15; and the Book of Francisco Rodrigues. Translated and edited by ARMANDO CORTESÃO. (Hakluyt Society Publications, 2nd series, vols. 89 and 90.) *London: Hakluyt Society*, 1944. 2 vols. 9×6 *inches;* xcvi+228 and 229–578 *pages; map in end-pocket and illustrations. 37s 6d per vol.*

In these two volumes Dr. Cortesão presents for the first time a complete version of a document of primary importance for Portuguese expansion in the Far East. The 'Suma oriental' is in fact the first systematic account to have survived of the countries, peoples, and commerce of the East as they were known to the Portuguese soon after their arrival in the early sixteenth century.

Besides Pires' work, the volumes also contain navigational notes and itineraries by Francisco Rodrigues, with reproductions of his manuscript charts, extending to China and the East Indian archipelago, and drawings of the coasts. Later in the century Ramusio published in his 'Viaggi' a translation of Pires, minus the all-important section on the Spice Islands, which he was unable to obtain, but without giving the author's name, and three centuries later the Viscomte de Santarem reproduced Rodrigues' charts, with a brief reference only to Pires. All trace of the manuscript was then lost until Dr. Cortesão found it in the Library of the Chambre des Députés in Paris. By making the Portuguese text and an English translation available, with a long introduction and extensive notes, he has made a valuable contribution to the study of historical geography.

Tomé Pires went to the East, as a "factor of the drugs," shortly after Malacca had fallen to the Portuguese, and after some months in India arrived in that seaport in 1512, and remained there until 1515. During this period he took part in a voyage along the northern coast of Java. When in India preparing to return home, he was appointed first Portuguese envoy to the Emperor of China. After many delays, he arrived at Canton in 1517 and proceeded to Peking. His subsequent history—he never returned from China—is traced by Dr. Cortesão in the introduction, but does not bear directly upon the present work.

The 'Suma oriental' is essentially an official report to King Emanuel on the commercial possibilities of the lands newly opened to western enterprise, as seen by an interested and intelligent observer. In form it is a systematic account of all the sea-board countries from the Red Sea to the China Sea. The main emphasis is upon the ports and their traffic, the products of the adjacent regions, the dues enforced, and the currencies, weights, and measures employed, but historical and general information, particularly on Malacca, is also included. Naturally Pires could not amass all this wealth of information single handed, and to his own observations he adds, after scrutiny, the testimony of his com-

patriots and of native pilots and merchants. Out of the accumulated detail there gradually emerges a striking picture of the contemporary trade relations of southern and south-eastern Asia. Pires shows the merchants of the countries between the Persian Gulf and the Mediterranean voyaging to the trading centres of western India, particularly Cambay and Goa, to exchange goods with merchants from the East, or moving on with the next monsoon to Malacca, where the cloves and other spices, porcelain, and silk of the east were bartered for the arms, cloth, copper, and glassware of Venice and the west. He was quick to see that control of Malacca was the key to this network, that the fortunes of the intermediary ports were linked with it, and that with tact the Portuguese could take over the whole system as a going concern. He summarizes all this in a terse sentence: "Whoever is lord of Malacca has his hand on the throat of Venice."

But Malacca was not the extremity of this long route. Its port was frequented by traders from the eastern archipelago, the islands of the China Sea, and China itself. From the reports of these men and those of his countrymen who had already ventured into these waters, Pires describes countries previously unknown to western Europe or known only from confused reports by a few earlier travellers. Thus for the first time there appear in western records the modern forms of place-names such as, to mention a few only, Canton (*Quamton*), Luzon (*Luções*), and Japan (*Jampon*).

Dr. Cortesão has elucidated obscure references, identified the numerous place-names, often very obscure, in the text, and compiled useful maps to illustrate it. The reviewer has two suggestions to make: it seems clear on p. 30 that Pires is describing the Caspian Sea. The confusion of the Tigris with the Kur was not unusual in medieval accounts, and the facts given fit the Caspian. It is possible that *Argangij* (p. 33) may be Urganj, the former capital of Khiva.

As a source for the history of the East in the sixteenth century these volumes are indispensable. G. R. C.

GENERAL

MAN, NATURE AND TIME: an introduction to world study. By W. A. GAULD. *London: Bell*, 1946. $7\frac{1}{2} \times 5$ *inches;* x+291 *pages.* 10*s* 6*d*

History is a study of the particular; so too is geography, at least in its human aspect. It is the more refreshing as it is rare that one like Mr. Gauld, whose training lies in these two fields, should permit himself to write in general terms. His thesis is that in a single world men should think in world terms and seek an eventual world-wide cooperation: a salutary recommendation to a world which, though it has long been conscious of its physical unity, reveals so blatantly fissiparous political and ideological tendencies. In contrast to many philosophical discussions, Mr. Gauld's rests firmly on an adequate foundation—a firm grasp of both the physical limitations of human habitats and the nature of historical processes. In contrast again to text-books about The World, Mr. Gauld's study gives us argument and synthesis more satisfying than objective, unevaluated, and unrelated facts of history and geography.

The book is well written and invites discussion: it is eminently suitable as an introduction for the student of geography, history, or international affairs. Mr. Gauld casts a wide net, and his discussion ranges over the manifold aspects of world society—physical, economic, political, demographic, cultural, and regional. He has wisely followed a line of thought, boldly crossing frontiers into the domains of the various social sciences and seeking guidance from their principal exponents. Doubtless, and inevitably in an outline of so wide a field, the reader is tempted here and there to alter or erase a line. It is probably untrue, for example, that (p. 184) "With the exception of Soviet Russia, there

is everywhere in Europe at present a falling population." Nor does Mr. Gauld indicate the assumptions upon which rest the predicted populations of England and Wales (p. 179). But such criticisms do not detract from the value of this book which focuses attention on the main and urgent problem of the day: that is, whether our world can be directed towards integration in human terms, or alternatively, whether it will head itself towards disaster. W. G. E.

LET'S GO CRUISING. By ERIC C. HISCOCK. *London: Robert Ross*, 1946. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 96 pages; illustrations, diagrams, and sketch-maps.* 9*s* 6*d*

This attractive little book is the result of many years' experience in small cruising yachts. It is written in an easy, straightforward way, it is packed with good advice for the beginner and the keen cruising man, and it is excellently illustrated with a large number of photographs and line drawings.

The author sets out to persuade the would-be sailor that seamanship in small boats is not so very difficult, that there is no reason why any one should not buy a boat and go cruising, and that it need not cost a great deal. The first chapter, on the beginner and his boat, gives good advice on choosing a boat and the advantages of different types and rigs. The two vessels illustrated here will be envied by many: *Wanderer II*, owned by the author, a tough little $4\frac{1}{2}$-tonner; and Pinckney's splendid *Dyarchy*, a 28-ton cutter built in Sweden.

The section dealing with seamanship is exceptionally good. In it are described two gales which the author experienced single handed in his own small cutter. In the first of these we read of the use and difficulties of a sea anchor. In the second we see how a small sailing craft can get through the worst of weather to her desired haven if she is handled aright. The main things are that the craft be well shaped, the gear sound, and sail shortened in plenty of time. Some would say that the *Wanderer* took a risk in attempting to weather the island of Gigha in a westerly gale under reefed staysail alone. She did so however, and reached West Loch Tarbert in safety, where we share the author's relief from an anxious time.

The chapters on pilotage and navigation are full of useful practical knowledge. The examples are taken from the author's own log books, which makes them more interesting and easier to apply than the usual text-book examples. Most space is rightly given to dead-reckoning and the instruments and methods of coastal pilotage, but enough astronomical help is given to enable a seaman to take a meridian sight and to use it. The author mentions the various methods for obtaining longitude, but has not space to describe them. Unfortunately he does not include the Air-Sea Navigation Tables described in the Admiralty Manual of Navigation, which is perhaps the quickest and simplest method of all.

The final chapter on the choice of where to sail is an epitome of the splendid cruising grounds near our shores. Few will read this part of the book without wishing to go by sea to Devon or Brittany, Cornwall or the Baltic, or to Ireland and the west coast of Scotland. The photographs in this chapter are most attractive and make a good comparison of the coasts and harbours described.

The book can be thoroughly recommended to any one interested in cruising, and especially to those who are taking up the sport from the beginning. A. C.

ERRATA

We regret that two errors appeared in the bibliographical reference to 'The Pleistocene period' by Frederick E. Zeuner, reviewed in the July–September number of the *Journal* (108 (1946) 102). The book is issued by the Ray Society (No. 130 in the series) and the publishers are Bernard Quaritch.

ADDITIONS TO THE LIBRARY

EUROPE

LANGUAGE AS A SOCIAL AND POLITICAL FACTOR IN EUROPE

By Stanley Rundle. $8\frac{1}{2} \times 5\frac{1}{2}$. 208 pp. Map. *London: Faber*, 1946. 12*s* 6*d*

ECONOMIC DEMOGRAPHY OF EASTERN AND SOUTHERN EUROPE

By Wilbert E. Moore (League of Nations: Economic, Financial and Transit Dept.). 9×6. 300 pp. *Geneva* (*pr. Princeton Univ. Press, N.J.*), 1945. $3.00

After examining present population densities and future trends, the author establishes index values for all commodities produced, revealing significant contrasts between western Europe and south and east (*e.g.* agricultural production per male worker: England, 240; Poland, 56; Yugoslavia, 43). He estimates that 45 per cent. of agricultural population in south and east is redundant, and examines problems of absorbing this in industry

PROSPECTS OF THE INDUSTRIAL AREAS OF GREAT BRITAIN

By M. P. Fogarty. $8\frac{1}{2} \times 5\frac{1}{2}$. xxxvi+492 pp. *London: Methuen*, 1945. 32*s*

THE ROAD GOES ON: a literary and historical account of the highways, byways, and bridges of Great Britain

By C. W. Scott-Giles. $10 \times 6\frac{1}{2}$. xii+236 pp. Illustrations. *London: Epworth Press*, 1946. 15*s*

THREE RIVERS . . . wanderings in the dales of Ribble, Hodder, and Calder

By Jessica Lofthouse. $8\frac{1}{2} \times 5\frac{1}{2}$. 300 pp. Illustrations. *London: Robert Hale*, 1946. 15*s*

THE CHURCHYARD YEW AND IMMORTALITY

By Vaughan Cornish. $7\frac{1}{2} \times 5$. viii+112 pp. Maps and illustrations. *London: Frederick Muller*, 1946. 6*s*

A discussion of the distribution of the churchyard yew in the British Isles. Dr. Cornish believes the yew was a sacred tree before Druidical times, hence its frequent occurrence in Wales. In southern England its distribution appears to be associated with church building activity after the Norman Conquest, so that the general age of the trees would be about nine hundred years

THE EVOLUTION OF KINGSTON-UPON-HULL

By G. de Boer. (*Geography*, 31 (1946) 139–46: sketch-maps)

L'ETUDE DES RELATIONS TECTONIQUES DU RELIEF ARDENNAIS ET SES DIFFICULTÉS

By J. Stevens. (*Bull. Soc. R. Belge de G.* 67–9 (1943–45) 117–27)

AURILLAC; géographie urbaine

By Alfred Durand. $9\frac{1}{2} \times 7\frac{1}{2}$. 256 pp. Maps and illustrations. *Aurillac: Imp. Moderne*, 1946

LES PAYS DE LA MOYENNE DURANCE ALPESTRE

By Paul Veyret. $9\frac{1}{2} \times 6\frac{1}{2}$. 596 pp. Maps and illustrations. *Grenoble: Arthaud*, 1944

LE PART DE LA GÉOGRAPHIE ET CELLE DE L'HISTOIRE DANS L'EXPLICATION DE L'HABITAT RURAL DU BASSIN PARISIEN

By R. Dion. (*Bull. Soc. G. Lille*, 1946, 6–80 illustrations)

IL CONFINE ITALO-FRANCESE. (*Le vie d'Italia*, 52 (1946) 681–7: sketch-maps and illustrations)

ZUR KARTOGRAPHIE UND MORPHOLOGIE DES DONAU DELTAS

By H. Slanar. (*Mitt. Geogr. Ges. Wien*, 88 (1945) 30–47: sketch-maps)

THE BASIS OF SOVIET STRENGTH

By G. B. Cressey. $8 \times 5\frac{1}{2}$. xii+288 pp. Maps and illustrations. *New York and London: McGraw-Hill*, 1945. $3.00

THE AGRICULTURE OF SKÅNE

[Eleven papers by H. Nelson and others; in Swedish with English summaries.] (*Svensk Geogr. Årsbok*, 21 (1945) 7–192: illustrations)

This province comprises 2·7 per cent. of the area of Sweden, but 15 per cent. of the arable land. The papers discuss the various types and standard of agriculture, and its relation to natural conditions. Wheat, rye, meat, and milk are important products

ESSAI SUR LA GÉOGRAPHIE GLACIAIRE DU BASSIN DE L'ARVE GENEVOISE

By A. Carozzi. (*Le Globe, Geneva*, 84 (1946) 24–38: sketch-maps)

IL MONTE CENERI. SCHIZZO DAL SUO PASSAGIO [TICINO]

By E. Dal Vesco. (*Geogr. Helvetica*, 1 (1946) 20–29: sketch-maps)

ASIA

THE END OF ARABIAN ISOLATION
By G. de Gaury. (*Foreign Affairs*, 25 (1946) 82–9)

NOTES ON THE PLEISTOCENE GLACIATION OF THE SOUTH CHINESE–TIBETAN BORDERLAND
By J. Hanson-Lowe. (*Geogr. Rev.* 37 (1947) 70–87: map and illustrations)

LES ORIGINES TECTONIQUES DE LA MALAISIE
By R. Cambier. (*Bull. Soc. R. Belge de G.* 67 (1943) 39–68)

TROPICAL LAND AND SEA BREEZES (with special ref. to the East Indies)
By G. H. T. Kimble and others. (From *Bull. Amer. Meteorol. Soc.* 27 (1946) 99–113: diagrams)

LAND UTILISATION IN THE DISTRICT OF 24-PARGANAS, BENGAL
By S. P. Chatterjee. (*Calcutta Geogr. Soc. Publns.* No. 6.) 9½×6. 66 pp. Calcutta, 1946

MANCHURIA: a key area
By H. Foster Bain. (*Foreign Affairs*, 25 (1946) 106–17)
Discusses economic and industrial developments and their importance for future of Eastern Asia

TRANSJORDAN: an economic survey
By A. Konikoff. 9×6½. 120 pp. Map. *Jerusalem: Jewish Agency*, 1946. 17*s* 6*d*

AFRICA

AFRICAN JOURNEY
By Eslanda G. Robeson. 8×5. 188 pp. Illustrations. *London: Gollancz*, 1946. 9*s*

ETHIOPIA UNDER HAILE SELASSIÉ
By Christine Sandford. 8½×5½. viii+150 pp. Illustrations. *London: J. M. Dent*, 1946. 10*s* 6*d*

SUDAN GEOGRAPHY
By R. A. Hodgkin. 10×6½. 160 pp. Maps. *Khartoum: Education Dept.*, 1946

SEASONAL BREEDING AND MIGRATIONS OF THE DESERT LOCUST IN EASTERN AFRICA
By Z. Woloff. (*Anti-locust Mem.* 1 (1946) 74 pp.; maps)

PHOSPHATE DEPOSITS IN TANGANYIKA TERRITORY
By G. M. Stockley. (*E. African Agric. J.* 12 (1946) 118–24)

THE GEOLOGY OF THE NAMWELE-MKOMOLO COALFIELD, UFIPA DISTRICT. [Tanganyika]
By R. B. McConnell. (*Bull. Imp. Inst.* 44 (1946) 227–50)

NOTES DE VOYAGE AU TRANSVAAL ET EN RHODÉSIE
By P. Legoux. (*Bull. Ser. des Mines A.O.F.* 2 (1945) 68 pp.)
A report on the mining industry of South Africa

THE EASTERN PROVINCE AS A GEOGRAPHICAL REGION. [Cape of Good Hope]
By V. L. Rennie. (*S. African Geogr. Journ.* 27 (1945) 1–27; sketch-maps)

BRITAIN AND WEST AFRICA
By Joyce Cary. (Pamphlets on British Commonwealth.) 7×5. 72 pp. Illustrations. *London: Longmans, Green*, 1946. 1*s*
A well-written summary of British relations with peoples of W. Africa, emphasizing recent developments in conception of trusteeship and colonial welfare. Though aware of shortcomings of indirect rule, the author stresses its value in securing cohesion in a transitional period

LES RESSOURCES MINIÈRES DE L'AFRIQUE OCCIDENTALE
By G. Arnaud. (*Bull. Dir. des Mines, A.O.F.* 8 (1945) 100 pp.; maps)

THE GEOLOGY AND HYDROLOGY OF THE VOLTAIAN BASIN [Gold Coast]
By N. R. Junner and T. Hirst. (*Memoirs Geol. Sur. Gold Coast*, 8 (1946) 50 pp.; maps)

AN ECONOMIC SURVEY OF THE WESTERN PROVINCE OF LIBERIA
By E. P. Hanson. (*Geogr. Rev.* 37 (1947) 53–69; map and illustrations)

CONTRIBUTION À L'ÉTUDE DE LA VÉGÉTATION DU SENEGAL
By J. Trochain. (*Mem. Inst. franç. d'Afrique Noire*, 2 (1940) 434 pp.; plates)

AMERICA

HOW OLD IS THE COLORADO RIVER?
By C. R. Longwell. (*Amer. J. Sc.* 244 (1946) 817–35)

OREGON'S WONDERLAND OF THE PAST—THE JOHN DAY
By Chester Stock. (*Sc. Monthly*, 63 (1946) 57–65)

DER SÜDEN DER VEREINIGTEN STAATEN
By H. H. Boesch. (*Geogr. Helvetica*, 1 (1946) 30–45; illustrations)

PRAIRIE IRRIGATION
By H. C. Long. (*Canadian G.J.* 33 (1946) 152–9; map and illustrations)

LA GLACIOLOGIA Y MORFOLOGIA DEL IZTACCIBUATL
By R. Robles Ramos. (*Rev. Geogr. Inst. Panamericano*, 4 (1944) 65–98)

EXCURSIONES GEOGRAFICAS Y ESPELEOLOGICAS POR EL OCCIDENTE
By A. N. Jimenez. (*Rev. Soc. G. Cuba*, 18 (1945) 43–72; illustrations)
Exploration of caverns in west of Cuba

LATIN AMERICA: countrysides and united regions
By R. S. Platt. 8½×6. x+564 pp. Maps and illustrations. *London: McGraw-Hill*, 1943. 25*s*

BOLIVIA'S AGRICULTURAL FRONTIER
By D. Weeks. (*G. Rev.* 36 (1946) 546–67; maps and illustrations)

THE NATURAL HISTORY OF YELLOW FEVER IN COLOMBIA
By Marston Bates. (*Sc. Monthly*, 63 (1946) 42–52)

DIE POSTGLAZIALEN ERUPTIVSSCHALTEN PATAGONIAS UND FEUERLANDS
By M. Salmi. (*Ann. Ac. Sc. Fenniæ*, ser. A, III, No. 2 (1942) 120 pp.; maps)

AUSTRALIA AND PACIFIC

MEN AND MANNERS IN AUSTRALIA; being a social and economic sketch history
By J. A. Allan. 8½×5½. 176 pp. Illustrations. *Melbourne: F. W. Cheshire*, 1945. 10*s* 6*d*

AUSTRALIAN CLIMATES AND RESOURCES
By J. Gentilli. 7½×4½. xii+334 pp. Maps and illustrations. *Sydney: Whitcombe and Tombs* (1946)
A physical, economic, and human study of Australia, New Zealand, and New Guinea, based upon climatic regions determined by Köppen's formulae. Much statistical information is incorporated in the text; there are a large number of sketch-maps, and a useful bibliography

ON GLACIAL LAKES IN THE KOSCIUSKO REGION
By J. A. Dulhunty. (*J. and Proc. R. Soc. New South Wales*, 79 (1945) 147–52)

PACIFIC SCIENCE: a quarterly devoted to the biological and physical sciences of the Pacific region. (No. 1, vol. 1, January 1947). *Honolulu: Univ. of Hawaii*, 1947. $3.00 *a year*

COOK AND THE OPENING OF THE PACIFIC
By J. A. Williamson. ('Teach yourself history' series). 7×4½. xii+252 pp. Sketch-maps. *London: English Univ. Press*, 1946. 4*s* 6*d*
A well-written account of Cook's three voyages, introduced by a summary of earlier Pacific exploration. Dr. Williamson brings out Cook's achievement in seamanship and navigation, and places his voyages in relation to contemporary European politics

MODERN TONGA
By C. G. F. Simkin. (*N.Z. Geographer*, 1 (1945) 99–118; sketch-map)

POLAR REGIONS

GÉOLOGIE ET STRUCTURE DE L'ARCTIQUE SOVIETIQUE
By P. George. (*Ann. de Géogr.* 55 (1946) 112–23; sketch-map)

SVALBARD UNDER OG ETTER VERDENSKRIGEN
By G. Aasgaard. (*Norsk G. Ts.* 11 (1946) 49–62)

ARCTIC MANUAL
By V. Stefansson (Prep. under direction of Chief of Air Corps, U.S. Army). 7½×5½. xvi+556 pp.; illustrations. *New York: Macmillan*, 1944. 15*s*

SCOTT, LE HÉRO DU POLE SUD
By Marthe Emmanuel. 7×5½. 142 pp. *Paris: Gigord*, 1946
A sympathetic biography based upon published sources

GENERAL

PLANE AND GEODETIC SURVEYING FOR ENGINEERS. Vol. I, Plane surveying
By D. Clark. 4th ed. rev. by J. Glendinning. 8½×5¼. xviii+636. Illustrations. *London: Constable*, 1946. 30*s*

THE SUN MAKES THE WEATHER
By C. G. Abbot. (*Sc. Monthly*, 62 (1946) 201–10; 341–8; illustrations)

FUNDAMENTALS OF ECONOMIC GEOGRAPHY
By N. A. Bengtson and W. Van Royen. Revised ed. 9×6. xxviii+802 pp. Maps and illustrations. *New York: Prentice-Hall*, 1946. (33*s* 6*d*)

THE PRINCIPLES OF ECONOMIC GEOGRAPHY
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Phot. Central Press

View in the ambulatory showing modern polar equipment at right and the "Aries" display lent by the Empire Air Navigation School in left background

Phot. Central Press

Another view in the ambulatory showing Watkins' kayak and a loaded Nansen sledge

Phot. Daily Graphic

Phot. Central Press

Model of a Canadian Eskimo kayak and a display of Eskimo clothing lent by the Hudsons Bay Company

THE MONTHLY RECORD

ASSOCIATE MEMBERSHIP OF THE SOCIETY

At a Special General Meeting of the Society on 17 March the Council's proposal to create an Associate Membership was approved. Associate Membership is open to all those between seventeen and twenty years of age, on the recommendation of a Fellow, University or School authority, and is intended to give to the younger generation of geographers the opportunity to share in the interests and activities of the Society. The terms of Associate Membership are set out at page ii of this *Journal*.

TRAVELLING FELLOWSHIP IN GEOGRAPHICAL RESEARCH

The Council invites applications for a travelling Fellowship open to University graduates and others wishing to undertake geographical research outside the British Isles. The Fellowship will be tenable for a period of not less than three months and not more than one year, and carries a stipend at the rate of £500 per annum. This has been made possible through the generosity of the Trustees of the Geographical Magazine Trust, whose Chairman is the President of the Royal Geographical Society. Holders of the Fellowship are not excluded from applying elsewhere for additional assistance towards travelling expenses. Candidates are requested to submit to the Director and Secretary, not later than June 1, particulars of their qualifications, a scheme of research, and a statement of how they propose to spend the grant. The names of two referees are also required. The Council expect that normally the results of a candidate's investigations will be communicated to the Society.

POLAR EXHIBITION AT THE SOCIETY'S HOUSE

Mr. Courtauld, who was responsible for the organization of the recent Polar Exhibition, contributes the following note :—

A small collection of polar equipment and relics of past expeditions was exhibited at the House of the Society during December and January. The purpose was to show the development of the technique of polar travel from the earliest times and to tell something of the story of Arctic and Antarctic exploration. Through the kindness of Fellows, their friends, other institutes, museums, and service departments, and in particular the Scott Polar Research Institute, the task of collecting material proved exceptionally easy. To arrange it all in the small space available was more difficult; however, with the tireless help of the staff, the exhibition was open at the beginning of the Christmas holidays.

The cases in the Museum were filled with relics of Polar explorers. These included the prayer book carried by Wilson on all his journeys and found with his body; the ship's articles of the *Terra Nova*, with the signatures of all Scott's men; Bowers' observation book with his calculations for the "fix" at the South Pole; the log of the *Quest* open at the page recording Shackleton's death, and a case of Eskimo ivory models. There were also the flags and banners carried by Ross, Markham, and other of the great figures of exploration.

The ambulatory was arranged with polar equipment, pictures, and photographs in order of time. One of the earliest specimens was a piece of Frobisher's "gold," a shipload of which he brought back from Greenland in the sixteenth century. The nineteenth century exhibits included the Barrow collection of model sledges, winter houses, ice saws, etc.

The Scott and Shackleton era was shown by a collection of photographs and by the Wilson pictures. Modern travel was represented by a weather station with a full display of meteorological instruments, a group of survey equipment, Watkins' kayak, a fully loaded Nansen sledge, and a display of equipment from the *Aries* flights to the North Magnetic and Geographical Poles. A modern camp was shown with a pyramid tent, sleeping-bags, and cooking equipment, and an exhibit of Eskimo clothing from Arctic Canada was provided by the Hudson Bay Company. There were also photographs from as many expeditions as could be collected. Items such as tents, rucksacks, boots, goggles, cooking-stoves, and sleeping-bags were lent by various firms. The polar animals were represented by specimens lent by the Natural History Museum, and the ships by scale models of *Discovery I* and *Penola*.

The new map room was given up to pictures and books. The portraits were an interesting collection of nineteenth-century travellers lent by the National Portrait Gallery. Most of them were painted to the order of Lady Franklin and represented officers who took part in the search for her husband. Here was shown a collection of Edward Wilson's sketches from the Antarctic; a living witness to the patience and devotion of that great naturalist and traveller. Here, too, could be seen some of the old files of *The Times* where one could read, among the gossip of the day, of events that live in polar history. Among these were the loss of Scott's South Pole party, the death of Watkins, and the finding of Andree's remains.

The final section of the exhibition, for which unfortunately there was insufficient room, showed examples of clothing developed by different services during the late war. These included submarine suits, flying clothing, and white clothes for snow warfare. Some apparatus had been sent from Germany to show the organization of secret weather stations which the enemy attempted to set up in the Arctic. One of their instruments was a wireless weather recorder which, taken up by balloon, automatically sent out signals giving the temperature and pressure at different altitudes.

Over six thousand people visited the exhibition in the five weeks it was open; of these a large number were school children. The Society would like to thank most warmly all those who helped with the exhibition, and especially the House staff under the Maintenance Officer, Mr. Lane, who worked many hours in off-duty time. We should also like to thank Lieut.-Colonel I. F. G. Hall, whose energetic assistance in the final stages of preparation was most valuable.

INSTITUTE OF NAVIGATION

The Society has recently put one of its Rooms at the disposal of the new Institute of Navigation. The Institute was inaugurated on 12 March at a meeting of its sponsors held in the Council Chambers of Lloyd's Register of Shipping. The inaugural resolution was proposed on behalf of the Royal Air Force and the Society by Air Chief Marshal Sir John Slessor, who also read a letter of goodwill from Marshal of the Royal Air Force Lord Tedder. Among those present who spoke were Captain R. W. Ravenhill, Director of Navigation, Admiralty; Sir Robert Watson-Watt for the Royal Society; Professor F. J. M. Stratton for the Royal Astronomical Society; Sir Charles Darwin, Director of the National Physical Laboratory; Air Chief Marshal Sir Frederick Bowhill, Master of the Honourable Company of Master Mariners; and Air Commodore G. I. L. Saye, Director of Navigation, Air Ministry, whose initiative has been chiefly responsible for the promotion of the Institute. Captain G. C. S. Saul of the Honourable Company of Master Mariners was elected Chairman of the Provisional Council, which includes among its members Mr. L. P. Kirwan, Director and Secretary of the Society, and Mr. A. Stephenson, Instructor in Surveying.

The Institute has as its main aims to unite in one body all those within the British Empire who are concerned with and interested in the science of Navigation, including navigators, teachers, and workers in research and industry, and to promote close contact with similar institutions abroad. It is thus intended to continue the coordination in the interests of navigation brought about by the war. The Institute will later provide a library of navigational books for its members and will publish a periodical journal.

While Fellowship of the Institute is reserved for those who have made a notable contribution to the science of navigation, all who are in any way interested in navigation will be welcomed to its Membership. Arrangement has also been made for scientific, industrial, and other organizations to become Corporate Members. Further information about the Institute and its terms of membership may be obtained from the Executive Secretary, Institute of Navigation, c/o Royal Geographical Society.

JOINT POLAR RESEARCH COMMITTEE

The Antarctic Research Committee, established by the Society in conjunction with the Scott Polar Research Institute to facilitate scientific cooperation in antarctic exploration and research with similar committees or institutes abroad, has been renamed the Joint Polar Research Committee. The composition of the Committee, which meets under the Chairmanship of Lord Wakehurst, was given in the July–September number of the *Journal* (108 (1946) 112).

UNIVERSITY NEWS

UNIVERSITY OF MANCHESTER

As a subject constituting an Honours School, Geography at Manchester, from the outset of its career, has been in the Faculty of Arts. Its place in the Faculties of Science and Commerce, if less prominent, seems to be however not only assured but likely to become more important than it is now. Its acceptance as a full Honours subject in the Faculty of Science will depend, it seems to me, on the extent to which Physical Geography, on its climatological as well as its geomorphological side, convinces the other sciences which are friendly but cautious that it is completely autonomous and capable of making its distinctive contribution at the highest level—and without a too-heavy leaning on Geology and Physics—to the body of scientific knowledge.

As probably in most other Universities, the demand for Geography both at the undergraduate and post-graduate levels is unprecedentedly strong. Reorganization of departmental administration, including a considerable enlargement of staff, is necessary to meet it and gives an opportunity for reforms which wartime restrictions had long postponed. At Manchester greater emphasis on cartography in all its aspects—including the historic, for which the Mills Collection is an admirable instrument—is assured. In addition, for the first time since the foundation of the Honours School in 1922, a choice between alternative regional courses—*e.g.* the Middle East and the Far East as alternatives—is offered to Honours students. Amongst other developments of importance is the parity granted to Social Geography in its relations with Economic and Political Geography.

One of the most needed reforms to be undertaken as quickly as possible is a differentiation between first-year Honours and Ordinary Degree candidates in respect of both the standard and subject-matter of their geographical courses; *e.g.* a course on the Principles of Geography is considered more suitable for

Honours students than an "Outline" course now to be reserved for Ordinary Degree students only.

Field excursions maintained regularly throughout the war years are continued and extended—there were three, each of one week's duration in 1945–46—and opportunities for the staff and students to study abroad are generously offered by the University. Research by individual members of staff is much encouraged by the staff increases already mentioned, and the days when lecturers, and even assistant lecturers, in Geography were supposed to be expert in each and every aspect of their subject are fortunately behind us. W. F.

UNIVERSITY OF SHEFFIELD

While some University Departments of Geography emerged from the war in makeshift or damaged premises, the Department at Sheffield is fortunate in entering upon the post-war period in up-to-date premises, designed for the purpose and opened in 1941. These comprise two lecture rooms (seventy and twenty-five seats), two practical rooms (thirty and twelve desks), a map room, a dark room, three private and two research rooms, and represent the fruition of many years' labour on behalf of the subject by Emeritus Professor R. N. Rudmose Brown. This session these rooms are full, with seventy first, twenty-two second, and eighteen third year students, but serious overcrowding looms only just ahead. The proportion of ex-servicemen in the first year entry is relatively low—only 40 per cent.—a fact related to the threefold expansion of the whole University which has now begun.

The teaching staff now numbers four, Mr. I. S. Maxwell having replaced Miss L. R. Latham who has moved to University College, Hull, and a new assistant lectureship having been recently created which is occupied at present by Mr. R. A. C. Savigear. Dr. Alice Garnett and Professor Linton have in recent months been elected to two offices which had been maintained single-handedly and with distinction over many years by Professor Fleure, namely, the Honorary Secretaryship of the Geographical Association and the Honorary Editorship of *Geography*. D. L. L.

UNIVERSITY OF DUBLIN (Trinity College)

The Department of Geography now has far more students than ever before in its brief history and the audiences at lectures are essentially cosmopolitan. The only Honours School of Geography in Eire, Dublin provides courses leading to the B.A. degree in Natural Science, in which students also take two of the following subjects: Geology, Botany, Zoology, Physics and Chemistry. So far, all the students have chosen Geology as one of the subjects combined with Geography, though this choice is not inevitable, if perhaps desirable. It would be difficult to run a full-time Honours course with a teaching staff limited to a Reader and an Assistant, but the general scientific training provides a basis for specialization after graduation and even, in some cases, in the final year of the four-year course. Dublin has one of the few surviving Diplomas in Geography, which is taken at an annual examination in September and has proved a useful qualification for many people who were unable to contemplate an Honours course; a number of candidates have possessed Honours degrees in other subjects. Work of particular merit is recognized by an award "with distinction." Most of the holders of this Diploma are now much-needed teachers of geography in Irish schools, but the Honours graduates have entered a variety of careers through the years. Pass courses are given to students for two years only: special short courses have recently been added for students in the Engineering School, and lectures are also given in the School of Commerce and the Church of Ireland Training College.

The acquisition of equipment has proceeded steadily for the past eleven years, and the Department is perhaps especially fortunate in possessing the services of a laboratory assistant who is an expert photographer and has built up a large slide collection. Like many other Departments, it needs more accommodation, but expansion has been impossible owing to war and post-war scarcities of building materials. The Department obviously has a special responsibility as a centre for geographical research in Ireland: at present work is proceeding on the city of Dublin, on the past and present limits of cultivation in the Wicklow mountains, and on glacial and glacifluvial deposits in the eastern part of the Lowland. The staff and senior students are actively interested in the work of the Geographical Society of Ireland and the publication of an annual Bulletin, now *Irish Geography*, has given an added stimulus to research: most of the illustrations and some of the articles have been produced by members of the Department. There is however so wide a range of problems awaiting investigation in Ireland that research workers from British Universities, willing to contemplate the not unpleasant experience of living for a time in Ireland, might consider the choice of this field of investigation. T. W. F.

JOURNAL OF GLACIOLOGY

We welcome the first appearance (Vol. 1, No. 1, January 1947) of the *Journal of Glaciology* which, unless the *Zeitschrift für Gletscherkunde* is revived, will be the only periodical in existence entirely devoted to glaciology. It is published by the British Glaciological Society, previously known as the Association for the Study of Snow and Ice, which was formed at Edinburgh in 1936 by the British delegates to the International Commission of Snow and Glaciers, of the International Union of Geodesy and Geophysics. The fact that the study of ice and snow in its various aspects comes severally within the range of geography, oceanography, geology, meteorology, climatology, and physics calls for a distinctive scientific name, and after careful consideration the committee of the society decided to adopt as the correct name for this science "glaciology," a term which has hitherto been restricted in some quarters to the particular subject of glaciers. Accordingly the editors of the new journal will welcome contributions on every aspect of the study of snow and ice. They will publish the domestic news of the society, including the papers read at meetings with the discussions which follow them.

Thus the present issue, after an encouraging foreword by Professor Ahlmann of Sweden, contains reports of meetings at which were read papers by G. Seligman, President of the Society, who develops the theory of "Extrusion flow in glaciers," by W. L. S. Fleming who describes "F. A. Wade's Antarctic researches," and by R. Moss and A. R. Glen who summarize the results of "Investigations on ice during the war." In addition there are shorter articles on a variety of topics including glaciated valleys, glacier flow, snow flakes, avalanches, the Rondane in Norway, ice erosion, Canadian snow research, Scottish snow conditions, and the snow survey of the British Isles which, after interruption in 1939, has been resumed and is to become an important part of the society's activities. Space is further allotted to correspondence, notes, and a fairly comprehensive glaciological literature comprising a bibliography for the period immediately preceding the war up to date, excluding for the most part however works on the polar regions which appear in the *Polar Record*.

Contributions to the *Journal of Glaciology* should for the time being be addressed to the Assistant Secretary, British Glaciological Society, c/o Royal Geographical Society. L. C. W. B.

THE ORIGIN OF PTOLEMY'S 'GEOGRAPHIA'

To the *Geografiska Annaler*, pt. 3–4, 1945, Leo Bagrov contributes a long and notable paper on the origin of Ptolemy's 'Geographia,' in which he advances some far-reaching conclusions. Students have recognized considerable differences between the text and the maps accompanying certain of the manuscripts, and have pointed out that, as they have come down to us, it would be impossible to construct the maps from the text or vice versa. This has led to the examination of the problem whether Ptolemy actually constructed maps to accompany his text, and whether the maps, as they have survived, are derived from them. It has also been recognized that passages in the text must have been inserted after Ptolemy's time. Dr. Josef Fischer, whose extensive work on Ptolemy, his maps, and the surviving manuscripts was reviewed at length in the *Journal*, 82 (1933) 65, concluded that the maps were originally drawn by Ptolemy. He accounted for the discrepancies noted above by assuming that the text and the maps were in the first instance one work, that they became detached from one another and circulated independently, receiving emendations, and that eventually they were brought together again.

Bagrov's thesis differs widely from these. Stated very briefly, it is that the 'Geographia' as it is known to-day is a compilation by a Byzantine scholar of the tenth or eleventh century who made use of works by Ptolemy and others, and that the maps were drawn even later, probably in the thirteenth century. In support of these hypotheses, Bagrov makes use of recent critical studies of Ptolemy's text and of research in Byzantine history; subjects Fischer's arguments to close scrutiny; and examines the problem in relation to general cartographic development.

His arguments range over too wide a field to be noted in detail here, and are occasionally not easy to follow. Among the points he makes is the heterogeneous character of the text, which includes what is essentially a text-book on map construction with lists of positions for the compilation of an atlas. He also argues that very little is known of the 'Geographia' between the second and the fifteenth centuries, that there are no clear references to the maps during this period, and that all manuscripts are of Byzantine origin. He also contends that western medieval cartography down to the Ebstorff and Hereford maps exhibits no acquaintance with Ptolemaic geography, which would be inexplicable if his maps were in circulation. His allocation of the compilation of the text from Ptolemy's treatise on map-making and his list of cities to the tenth century and of the maps to the thirteenth century is based upon an analysis of their contents and of conditions in European Sarmatia (western Russia). Finally he has found in Byzantine literature a statement that Maximos Planudes (1260–1310) had obtained a manuscript of Ptolemy without maps, and had himself drawn maps to accompany it. These were copied by order of the Emperor Andronicus. The suggestion is also advanced that Planudes was associated with the Mount Athos codex, which also contains maps. Bagrov believes that Planudes was responsible for the twenty-eight maps of version A, and that possibly Nikephoras Gregoras (1295–1359) drew the sixty-eight maps of version B. He concludes with the hope that scholars of Byzantine literature and history will give their attention to the 'Geographia.' His thesis raises a number of problems, to which he suggests possible answers; whether they are ultimately accepted or not, he has given a new direction to Ptolemaic studies. G. R. C.

THE PROBLEM OF SLOPE DEVELOPMENT

In 1940 the Association of American Geographers devoted an issue of the *Annals* (33 (1940) 219–84) to a thorough survey and discussion of Walther

Penck's contribution to geomorphology. This reached the eyes of British workers when the fortunes of their country were at greatest hazard and when they had neither leisure for thought nor opportunity for field-work. The time now seems ripe for a vigorous assault on some of the problems arising.

Penck's general thesis carries many wide and important corollaries, but as regards slopes the major question at issue may be briefly stated as follows. Davis regarded slope as a function of "stage," the steepness of slopes decreasing with the passage of time, while Penck correlated convex, concave, and "plane" slopes with accelerating, declining, and uniform uplift respectively, and he believed that, in general, slopes were subject to "parallel retreat."

The papers and comments contributed to the American discussion reveal an appreciable concurrence of view on this question, and we may note a few of the opinions expressed. J. Leighly considered that the Davis and Penck systems are not mutually exclusive, but that both contain parts of the truth. He insists however that Davis erroneously assumed that we know the nature of slope formation, while Penck's treatment implies that we do not. Douglas Johnson stoutly maintained the Davisian viewpoint and characterized the idea that the form of slopes reflects rate of uplift as one of the most fantastic every introduced into geomorphology. He claimed, as a fact of observation, that convex and concave slopes commonly co-exist within the same valley and regarded the general case as the inflected slope, convex above, concave below. He denied the parallel retreat of slopes except in the special case of basal sapping by river action. Against this may be set the shrewd comment of G. B. Cressey that the very existence of monadnocks proves the reality of parallel retreat, a statement on the face of it difficult to gainsay.

The important paper by Kirk Bryan opens with the statement that the doctrine of Penck came with "all the effect of a cold shower on a complaisant reveller. Slightly bemused by long, though mild intoxication on the limpid prose of Davis's remarkable essays, he wakes with a gasp to realize that in considering the important question of slope he has always substituted words for knowledge, phrases for critical observation." He supports Johnson in rejecting the Penck doctrine of convex and uniform slopes, but in the third type of slope development discussed by Penck—"absteigende entwickelung," which begins when uplift is complete—he sees important elements of truth. He briefly restates the case for assuming that in arid climates slopes are characteristically steep and retain their steepness during development. Our limited knowledge of slope development in humid tropical climates suggests that, though the processes are different, the results are comparable—steep slopes subject to essentially parallel retreat. In the temperate humid regions, gentler slopes prevail and the legacy of former glacial or periglacial conditions is a grave complication in quantitative study. Bryan suggests however that in the case of an eminence such as Mount Monadnock there is nothing in our knowledge of the processes at work to render it unlikely that the slopes have been, and will continue to be, subject to parallel retreat.

Here is the challenge to investigation which it is hoped that British geomorphologists will accept. What is wanted at present is not further discussion of the theoretical matters involved, but more facts. Whether quantitative experimental work in the field holds any hope of tangible result is perhaps open to question. It would need in any case to be long continued and would require careful organization. It is certain however that slopes in the diversified landscapes of Britain merit renewed scrutiny, with particular reference to the detail of their form and the processes concerned in shaping them. British teachers and students of geomorphology have certainly been guilty of the uncritical accept-

ance of the highly illogical assumption that escarpments show "parallel retreat," while valley slopes flatten with age. Among recent British contributions to the field of study we may note the important paper of Hollingworth, Taylor, and Evans in *Quart. Journ. Geol. Soc.* (100 (1944) 1–44), and the most valuable discussion by Alan Wood in *Proc. Geol. Assoc.* (153 (1942) 128–40). S. W. W.

MEGALITHIC CORRELATIONS WITH THE LUSITANIAN FLORA

In his paper in the July–September number of the *Journal* (108 (1946) 28), Colonel Stern refers to the problem of the Spanish flora in Ireland. The Lusitanian element of the Irish flora is a group of eleven species found mainly in south-west Ireland (in Co. Clare, Limerick, and especially in Cork and Kerry), and in north-west Ireland (especially in Galway, Mayo, and Donegal). One outlier (*Glyceria Foucaudii*) is found around Strangford Lough and a second, London Pride, occurs on the cliffs of Lugnaquilla and Conavalla, two southerly Wicklow peaks. In Spain the group is scattered between north Portugal and Galicia and the Pyrenees, though individual members have a wider distribution which may extend into southern Spain and around the Mediterranean shores. Intermediate stations of this flora are on the western fringe of France (*Simethis planifolia*, *Arbutus Unedo*, *Euphorbia hiberna*, and *Glyceria Foucaudii* occur sporadically between Normandy and the western Pyrenees) and, with the exception of *Arbutus*, the same species occur in south-west England. Two heaths, *Erica ciliaris* and *E. vagans*, together with *Lobelia urens* occur in the south-west English peninsula and in Lusitania, but there are no satisfactory records of them from western Ireland.

The concensus of opinion among Irish biologists is that the Lusitanian flora, together with a small group of snails, woodlice, spiders, and beetles, is a relict group which survived the Quaternary Ice Age. Their views, and the case for survival, were stated by Praeger in his presidential address to the Royal Irish Academy (*Proceedings*, 41 (1932) 125–45). Colonel Stern suggests that prehistoric navigators coasting along the Atlantic shores may have brought the Lusitanian flora to Ireland. When I raised this possibility, in a contribution to Dr. Marion Newbigin's 'Plant and animal geography,' I did so at an early stage in the regional differentiation of types of megalithic monuments, the least destructible relics of the period suggested by Colonel Stern. It is now possible to correlate the floristic distribution with that of a particular form of megalith, but before doing so one may note that the final proof lies in the identification, technically difficult, of remains of Lusitanian species in peat contemporary with, but not earlier than, the megaliths in question. These are a late form and continued to be built in the early Bronze Age; the period is nearer 2000 B.C. than 2500 B.C.

By this time the Channel had probably assumed its present form. The use of the Irish Sea basin by the megalith builders is not due to an avoidance of the "dangerous" Channel (one doubts if it was more dangerous in its restricted form), but to the greater potentialities offered by its mountain-strewn shores to peoples who needed hard fine-grained rock for their implements and tombs. By 2000 B.C. coastal voyages were a well-established feature of Atlantic Europe and one may postulate that settlers moving northward included in their supplies roots and seeds which would subsequently produce food crops. It is suggested that the Lusitanian species, and, as gardeners will appreciate, the small invertebrates, were accidentally included.

Different groups of Neolithic and early Bronze Age peoples built different styles of graves for their dead. The most common grave-form of the areas in question is the unsegmented gallery grave, sometimes formed by two parallel

lines of stones, in other cases laid out in the form of a wedge. It is not divided by transverse stones to form a line of chambers, though at the entry a small antechamber may be marked off by transverse stones from the main gallery. These tombs, and the shorter rectangular or wedge-shaped chambers—"dolmens"—into which they later degenerated, are dominant to the exclusion of almost every other type of megalith between Galicia and the French side of the Pyrenees, and in Cos. Clare, Limerick, Kerry, and Cork. South-west Ireland appears to be the classic area of their occurrence in the British Isles. They also occur, as do the floral elements, in the heathlands of western France, and both unsegmented galleries and wedge-shaped single chambers (*e.g.* the famous Zennor and Trethevy Quoits of west and east Cornwall) are represented in south-west England. The Irish distribution of the unsegmented gallery is not yet completely surveyed, but it seems to be fairly widely scattered in those parts of Connaught and Donegal over which the Lusitanian flora spreads. Northern Ireland and the east of Eire have no Lusitanian floral elements except the two cited above. They have a few unsegmented gallery graves, but these appear to have spread there from western Ireland and there is nothing to equal the numbers of, say, the belt of country reaching north-eastwards into southern Tipperary from the ria landfalls of the Kenmare River and Bantry Bay. The gallery graves of Northern Ireland, like the chambered galleries across the North Channel in Scotland, are almost all segmented. No unsegmented types have, as yet, been identified south of Belfast Lough. Thus the nearest occurrence of the type to the Strangford Lough location of the Lusitanian species is in Co. Antrim. But there are three gallery graves on the Wicklow hill spurs which radiate southwards from Lugnaquilla and all are unsegmented.

Praeger suggests that the 42° F. January isotherm is the critical temperature for the Lusitanian flora, with a lowering of 3°–11° in hilly districts. The Irish and south-west English areas of the Lusitanian species all have January averages above 42° F. and unsegmented galleries are the dominant megalithic type. But most of Pembrokeshire, Lleyn, and Anglesey have a higher January average than 42° F., as have North and South Uist and Tiree. In none of these areas are Lusitanian species or unsegmented galleries represented. If the Lusitanian species form a relict of the pre-glacial flora, could a case not be made for their survival in the unglaciated fringe of south Pembrokeshire such as Praeger has postulated for the coastal fringes of south-west Ireland? Or may we not suggest that the explanation lies in the fact that only those areas settled about 2000 B.C. by peoples originating in the north-west Spanish and Pyrenean region have a Hiberno-Spanish flora?

MARGARET DAVIES.

RESEARCH IN THE SOVIET UNION

The Soviet Academy of Sciences has drawn up a Five year plan of research as part of the general plan for the Soviet Union. The main lines are summarized by the President of the Academy, S. Vavilov, in *Soviet News* (26 September 1946). The guiding principle is to coordinate the theoretical requirements of scientific advance with the practical problems of the Union. Research by geophysicists, geologists, and geographers therefore, while mainly directed to the area of the Union, is intended to embrace general problems, such as the internal structure and physical properties of the earth and the mechanism of tectonic movements, as well as the seismography of the Union, geophysical methods of prospecting for minerals, and continued investigation of geological resources. Special emphasis will be placed on research into the geology of oil and on soil science, particularly the problem of frozen soil. The success of much of this work will depend on cooperation with the various ministries directly concerned.

Another subject of more general significance to be studied is the structure of the Pacific coast, and the processes to which it is now subject. The plan also envisages investigations into the theory of ocean currents and tides, storms and their effects on coast-lines, the problem of the thermal and dynamic interactions between the ocean and the mainland, and the structure and composition of the stratosphere. As already noted in the *Journal*, geographers are compiling a geography of the Union in eight volumes. Attention is to be given to the laws of development of the surface of the country and the history of its formation.

In January 1947, the second All-Union Geographical Congress was held at Leningrad. A paper on the origin of the earth and the solar system was read by Otto Schmidt, who considers the age of the earth to be about seven thousand million years, the crust having been formed two to three thousand million years ago. Admiral Lapushkin also lectured on the hydrographical study and mapping of the seas of the Soviet Union. Leo Berg was re-elected President of the Soviet Geographical Society, and V. Obruchev an honorary president. Members of the Council include Schmidt, Weise, and Papanin. The Congress decided to publish a new geographical dictionary of the U.S.S.R. in several volumes, and the Central Geographical Museum in Leningrad is to be restored.

As was pointed out by Professor Ahlmann (*Geogr. J.* 106 (1945) 221), Soviet scientific publications are almost entirely in Russian, and are generally unaccompanied by summaries in other languages. It is to be hoped that means may be found of making the results of these researches more generally available in this country.

AWARD OF STALIN PRIZE TO PROFESSOR WEISE

The announcement has recently been made of the award of a Stalin Prize to Professor Vladimir Weise. Professor Weise, who is Chairman of the Arctic Institute at Leningrad, began Artic work as a member of Lieutenant Sedov's Expedition on the *St. Foka* in 1912, when he made studies in Novaya Zemlya and Franz Josef Land. Of his later voyages, the most notable are those in the *Sibiryakov* in 1932, before the opening of the Northern Sea-route. He made the first east-to-west journey in a single navigational season in the *Lidke* in 1934, and two years later he was in command of the expedition in the *Sadko* to the Kara and Laptev Seas. Professor Weise has specialized during this time in the study of sea ice, and more particularly in forecasting ice movements, with notable success. The discovery of Weise Island in 1930 was more or less predicted by him several years earlier and has been named on this account. Professor Weise's investigations are summed up in the 'Foundations of long-term forecasting of ice formations in the Arctic Seas' published in 1944, and he is at present at work as chief editor on a proposed 'Geographical atlas of the Arctic.'

THE NAME ROMANIA

The name Romania has a variety of linguistic, historical, and political implications, and its spelling is in dispute. In 1939 the Romanian Legation was Romanian according to its letter-head, Rumanian according to the brass plate on the door, and Roumanian in the 'London Telephone Directory.' The name was the subject of an inconclusive correspondence in *The Times* in August and September 1940.

Meyer-Lübke maintained that the old Roman Empire or Latin-speaking world was called Romania during the Middle Ages. He should perhaps have added "by Europeans," for the lands of Christendom were then called Rūm by the Saracens. The Muhammedan traveller Ibn Jubayr shipped from an Andalusian port on a vessel of Rūm late in the twelfth century, and passed on his way

to the East between the islands of Romania, identified as the Archipelago. After the final defeat of the Eastern Roman Empire in 1204, the Franks established the short-lived Empire of Romania with its capital at Constantinople; and the name Romania seems to have lingered, as that of lands at the head of the Aegean, at least until the establishment of Turkish power in Europe was generally acknowledged. Nauplia (Navplion) in southern Greece is still conventionally known to Italians as Napoli di Romania.

Older English atlases, from Speed (1626) through Bowles (1708) and Senex (1721) to Kitchen (1782), attached the name Romania to a vaguely delimited region covering parts of Thrace and Macedonia. In 1774 however, Dunn showed this region as Roumili, which was the Turkish name for Turkish possessions in Europe. Kitchen called it Romelia in 1794, and thereafter Romelia or Rumelia displaced Romania in English atlases.

The descendants of the old Latin-speaking peoples on both banks of the lower Danube had come to style themselves Romeni, Romani, Rumeni, or Aromuni from very early times. Those of Moldavia, Wallachia, and Transylvania called their country "ţara românească"—"the Romanian country." In 1859 the Representative Councils of the Principalities of Moldavia and Wallachia voted unanimously for union into a single state to be called România. The union was ratified by the Powers in 1861. But not until 1882, it seems, did the name again begin to appear in English atlases, when it appeared in the form of Rumania (Philip's Imperial Atlas) and in a different place. Its old place in seventeenth- and eighteenth-century atlases was taken by the name Rumelia.

Modern philologists employ the name Romania much as it was used in the Middle Ages, to denote the whole area over which Romance languages are spoken. They are obliged therefore to refer to the modern kingdom as Rumania or Roumania. A journal called *Romania*, devoted to the Romance languages, was founded in Paris in 1872. These languages are divided into an eastern and a western group, distinguished in part by their systems of stress. România is the stress of western, Romanía that of eastern Romance.

Geographical names in Rom- preponderate heavily over those in Rum- in Hungary and Romania, and markedly in Greece; but the two groups are fairly balanced in Yugoslavia, Bulgaria, and Russia. Romanian authorities, including the Royal Romanian Geographical Society (Societatea Regală Română de Geografie) prefer the spelling România, which the Permanent Committee on Geographical Names recommends, though without the circumflex, for British use. The reasons for the existence of the English conventional spelling Rumania, and the French Roumanie, are obscure. According to Logio the Bulgarian liturgy was in use in Romanian churches during the Middle Ages. Romanian was first written in Cyrillic (old Slavonic) characters, and its gradual romanization was not complete until 1890. The late Sir Stephen Gaselee supplied the Cyrillic spelling рѣмѫнѣѧскъ for the word românească, the ѫ being a late Byzantine ligature for *ou*. It seems possible that the Romance pronunciation of some Romanians was corrupted by Slavonic influence. On the other hand, the name Rumelia was better known during the nineteenth century than the name Romania, and may have corrupted the pronunciation of the latter by foreigners.

In a part of the world where it must often be necessary to distinguish between things Roman, Romaic, and Romanian, the ῥωμαϊκός, ῥωμαΐικος, and ρουμανικός of modern Greek seem inevitable. In modern Romanian, a Roman and a Romanian are distinguished as Roman and Român respectively. Dictionaries (de Pontbriant, the 'Dicţionar complet' of 1917, and Schönkron) reject the spelling Rumân, or give it only as a cross-reference to Român. Romanians who write Rumanian or Roumanian in English context probably do so because they

believe it to be correct English usage. There is a case for Rumania as a conventional English spelling, but none for the hybrid Roumania.

Those interested in tracing the Moslem use of the name Rūm, and the Christian use of the name Romania, should refer to the paper "Entstehung und Wanderungen des Namens 'Rumelien' " (*Österreichische Monatsschr. f. d. Orient*, 23 (1897) 128–9), by C. von Sax, and to "Valore territoriale del nome 'Romania' negli annalisti genovesi del xii e xiii secolo" (*Riv. geog. Italiana*, 34 (1927) 36–45), by Mario G. Celle. M. A.

CLIMATE AND MAN IN CHINA

In the *Annals of the Association of American Geographers* (36 (1946) 44–73) Mr. Chi-yun Chang gives a useful general account of the climate of China in the wider sense mainly from the human point of view. He describes seasons, humid and arid regions especially in relation to agricultural crops, the exacting droughts and terrible floods so characteristic of the country, the peculiarities of mountain climate, and the vexed question of climatic changes particularly in Sinkiang. Comment may be passed on one or two aspects of the subject which are not so generally familiar.

Thus the author objects to the term "monsoon rain" as applied to the summer rainfall of China, on the ground that when the south-east summer wind blows steadily and persistently drought is imminent, a fact which often creates misunderstanding. The moisture is of course brought by the south-east monsoon from the warm Pacific Ocean, but it cannot become available for condensation into rain unless the south-east wind interacts in cyclonic depressions with colder and drier northerly winds. Such depressions form over the Yangtze valley, and elsewhere, and move north-eastward with the upper currents. Much the same thing happens in Western Europe. Steady south-west winds, charged with the moisture of the Atlantic Ocean, cannot bring much rain to the British Isles until they come into conflict with colder and drier polar winds in association with depressions and fronts. But in Eastern Asia the situation is rendered more paradoxical by the fact that the summer monsoon surface indraught towards the low-pressure area over Central Asia is in the opposite direction to the planetary circulation from the west in which the depressions move.

A prominent feature of the landscape in the north-west of China, especially in the Liupan Shan and other mountains, is the difference in vegetation between the sunny and shady sides of the mountains which the Chinese geographers call the "yang" and "yin" slopes. The southward-facing or yang slopes receive more sunshine than the yin or northward-facing slopes. This results in the soils of the yin slopes being constantly drier and cooler than those of the yang slopes, so that there is a considerable difference in vegetation under similar conditions of rainfall. Where the southerly slopes are covered with short grass, the corresponding northerly slopes bear long grass and bush; where the latter grow on the south, forest flourishes on the north. On the higher mountain tops the rainfall may suffice for forest on both slopes. This relationship, in which the governing factor appears to be moisture, is, of course, only applicable to this particular region. In cooler latitudes the sunnier slopes would be the more fertile.

Towards the end of the paper the author discusses the question of climatic change in the Tarim Basin of Sinkiang. He points out that the desiccation theory of Ellsworth Huntington in explanation of the movements of the Asiatic tribes in medieval times is not entirely supported by the observations of Sir Aurel Stein and others. Stein concluded that though the present dry conditions were already prevailing at the time of Christ, the rivers of the Tarim basin

carried a greater volume of water than they do now. He thought that the anomally might be accounted for by a slow but continuous shrinkage of the glaciers in the high ranges since the close of the last glacial period. It is however very unlikely that even the large quantities of ice which may have covered the mountains of Central Asia during the last glacial period should not by now have been sufficiently reduced for equilibrium with the present-day snowfall. It would be more in keeping with modern glaciological ideas to suppose that two thousand years or so ago the rivers of Sinkiang were merely feeling the effects of a comparatively recent temporary advance of their feeding glaciers.

L. C. W. B.

CONTEMPORANEOUS DISTURBANCES IN LACUSTRINE BEDS IN KENYA

In an article under this title in the *Geological Magazine* (82 (1945) 130–35) P. E. Kent discusses exposures recently discovered on the eastern shores of Lake Victoria. The disturbances occur in the Lower Pleistocene Kanam beds, and to a lesser extent in the overlying Lower-Middle Pleistocene Rawe beds. Homa volcano was then active and contributed largely to the deposits. The simpler structures consist of gentle anticlines and synclines formed in ash beds, with a wavelength of from 3 to 20 feet, often with similar beds, still horizontal, occupying the synclines. More characteristic is the intense folding and shearing in now brittle beds, one flat-lying nappe structure measuring fully 30 feet in length and 8 feet in thickness.

The overlying sediments cannot have exceeded 200 feet, but the folded sediments lost some of their initial water during folding, for they proved soft and plastic, though not fully fluid. The whole process of deposition, partial compaction, and sliding occurred within about ten thousand years. The folding probably resulted from slipping, under gravity, of a sheet of partly consolidated sediments over a tilted surface of hardened beds; the striking character of the folding—with so little fracturing—is attributed to the tensile strength of the sediments while they were still plastic. The absence of rucking in the underlying beds resulted from the juxtaposition of strata with very different mechanical characteristics. At least in one case the slipping was due to contemporaneous tilting, rapid compared with the rate of sedimentation, at the time of the extrusion of the most widespread of the Pleistocene lava flows from Homa.

Evidence such as the author presents is always welcome, in that an appreciation of small-scale folding contributes eventually to the understanding of similar large-scale structures within the earth's crust. W. V. L.

RISE IN LEVEL OF THE MWERU SWAMP, NORTHERN RHODESIA

In the *Journal* for June 1898 Mr. Hector Croad, who still lives at Abercorn at the south end of Lake Tanganyika, gave a description of the Choma administrative division and in particular of the Mweru Swamp ("The Choma division of the Mweru district," *Geogr. J.* 11 (1898) 617–24). It may be of interest to record a few notes on the present condition of the swamp. The following is what Mr. Croad wrote almost fifty years ago:

> "Though it is called the swamp, there is not much swamp about it. There is a stretch of swamp at the north end, where the Choma enters the plains, and another at the south end. It is a huge stretch of nearly level plain (with short grass along the edges), anywhere on which, on a clear day, one can see the surrounding hills. When the rains start, the grass grows fast, and reaches to a height in some places of 10 feet and over. . . .
>
> "The water lies about a foot deep in the summer, over a large stretch of

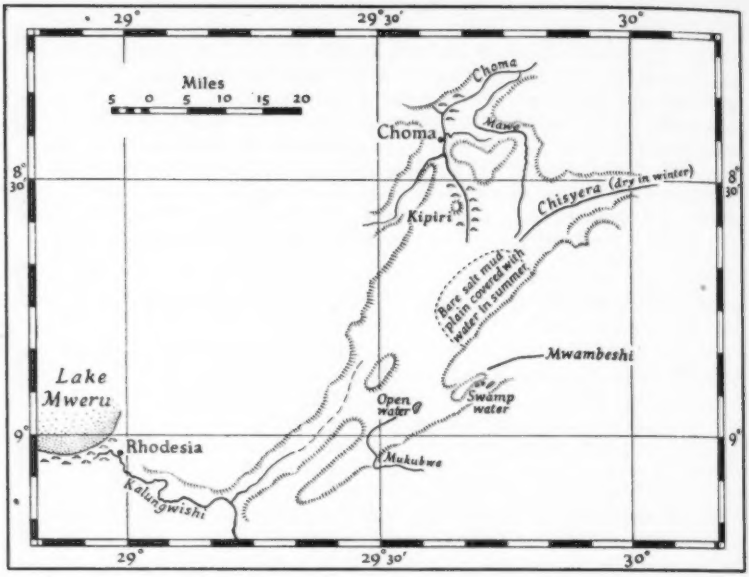

Fig. 1. Mweru district in 1898 (after H. Croad)

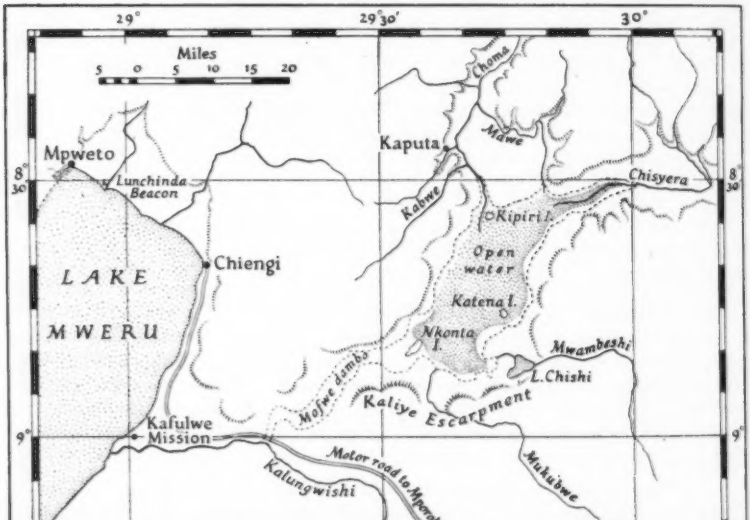

Fig. 2. Mweru district to-day (Anglo-Belgian Boundary Survey, 1913, revised by F. B. Macrae from traverses made in 1940–45)

these plains, which at the north end, near the Choma and Chishyera, are much cut up by small spruits and hippo tracks. The water soon dries up, however; practically no water finds its way from the swamp into the Kalungwishi river, on which Rhodesia station is built. The Mofwe, which at one time must have been the outlet, has next to no current now. There used to be far more water here, from what the natives say, as at one time they had to use canoes to get from the edge to the Kipiri (a small hill in the centre), which may now be done with dry feet. In August the grass dries up and is burnt off, but soon springs up again and gets dry; and the fires seem to go on burning below the surface, for as soon as a little wind springs up, the fires run through again, sometimes three times. . . .

". . . The shores of the plain are sandy and I have not the least doubt that it was once a large lake. In fact, almost up to Mkula's, one sees along the sides of the hills a line, sometimes more than one, of round wave-washed stones, showing where the old shores were; and, coming down to these, one sees the paths that hippo make when they nightly leave the water. . . .

". . . The Mweru swamp in November is the best place I know of for elephant. . . ."

The interesting thing about this region to-day is that the former swamps and open plains are now a large lake some 40 miles long and 15–20 miles broad. The Chishyera, which Mr. Croad mentions as being dry in winter, is now a broad arm of this lake running 12 miles inland from the main sheet of water. The hill Kipiri, and another small hill Katema, are islands on which fishermen take refuge during storms. The lake produces many tons of fish a year. Hippo abound in it, and pelicans can also be seen. The elephants have all but disappeared. The locality has become unsuitable for them and it seems that they have moved away to the west into what is now the Sumbu game reserve.

There is no apparent reason why the swamp should have become a lake. It cannot be because an outlet has been silted up, for there is no outlet. The Mofwe dambo falls gradually away from the Kalungwishi river and there is about 100 feet difference, by aneroid, between the two ends of the dambo. Nor is there an outlet in any other direction. In time of flood, from February to April, the Kalungwishi river divides and some of its waters find their way into the swamp. It may be that this has not always happened, but even so the flow is never so considerable as to seem to account for the lake. Moreover, in a year when the rainfall is generally below average, the Kalungwishi does not rise high enough to discharge its waters. This has happened during the past rainy season of 1945–46. It remains to be seen if this failure will make any fundamental difference to the level of the water.

The lake itself is shallow: it is probably never more than 15 or 20 feet deep. The waters of the swamp are not brackish despite the fact that there is no outlet. It is almost surrounded by a deep fringe of papyrus, but at one or two places on the eastern side high bluffs come down to the water's edge and there are patches of rocky shore. Here fishing canoes are kept in considerable numbers by the inhabitants of nearby villages. A salt industry at Kaputa at the northern end of the swamp, noticed by Mr. Croad, is still flourishing. It has not been flooded out, though in extra wet years the yield is generally somewhat diminished owing to the rise of the water.

There seems to have been a similar rise in the nearby Lake Mweru, as one of the survey beacons erected by the Anglo-Belgian Boundary Commission in 1913, at the mouth of the Lunchinda river, was reported under water in 1940 and again in 1944.

F. B. MACRAE.

THE POPULATION AND CULTURE OF BRAZIL

The final results of the Census of Brazil, 1940, are now being published by the Instituto Brasileiro de Geografia e Historia. We have received a summary of the results (Sinopse do Censo demográfico) and volume I of the national series. The total population in 1940 is returned as 41,236,315, the increase in the inter-census period 1920–40 being 34·6 per cent. The average density is calculated at 4·85 per km.^{2} Of the total, 26·2 million, or approximately 63 per cent., are white, 6 million negroes, and 8·7 millions *pardos* (mixed). One-third of the people are literate. The growth of population was particularly marked in the south, where it amounted to 59 per cent. over the period; the population of the State of Saõ Paulo rose from 4·6 to 7·2 millions. This percentage was exceeded only in the centre-west (Matto Grosso, Goyaz) where it reached 66 per cent., though this was an increase from half to three-quarters of a million only. Though all the other physical divisions showed total increases, three smaller areas declined absolutely: the Territory of Acre and Pará in the Amazon basin, and Alagoas on the north-east coast. The average densities of population show striking contrasts. In the north, that is, most of the Amazon basin, it is 0·44 per km.^{2}, and in the centre-west, 0·59; at the other extreme, it reaches 12·68 in the east (Rio de Janeiro, 43·58) and in the south, 15·86 (Saõ Paulo, 29·04). At a generous estimate, the total population of the Amazon basin is about two and a half millions.

The evolution of these conditions and their significance for the future are discussed in the first volume of the National series, 'A cultura brasileira: introduçaõ ao estudo da cultura no Brasil,' by Professor Fernando de Azevado, a substantial and well-illustrated work. The author's avowed concern is not with the manifestations of material civilization, but with the moral, intellectual, and artistic achievements, which rise above considerations of social utility, and by their creative and critical force propagate spiritual ideals and values. He introduces his study however with an analysis of the environment within which this culture must flourish, and this section on the country and the people, their social evolution and their work, will probably be of most interest to geographers. He then deals with the cities as centres of cultural progress, the development of religious, literary, and scientific life, and concludes with the growth of educational institutions and their function in transmitting the national culture.

Professor de Azevado emphasizes the existence in the past of the two great "eccentric" regions, the Amazon basin and the southern highlands, and the importance as a link of the north-eastern region, and particularly the Rio Saõ Francisco, the "rio da unidade nacional." The overriding purpose of national policy must be to integrate these not only in the national framework but in that of South America as a whole by breaking away from the marginal distribution of population. The country would then cease to revolve in the orbits of Iberian and Anglo-Saxon civilizations. For this the essentials are policies of population, penetration, communication, and transport, but above all the unity of common nationality. In respect of the latter, he points to the increase in immigration which in the last century has radically altered the composition of the population, raising the white elements from about a quarter of the total in 1835 to nearly two-thirds to-day

G. R. C.

JOURNAL REPRINTS

In response to requests from readers it has been decided to make generally available small stocks of reprints of papers in the *Journal* which are of special interest. Reprints of the first three papers in this *Journal* may be bought on demand from the Office of the Society at an average cost of *1s 6d* each

CORRESPONDENCE

GEOGRAPHY AND ITS COMPONENTS

I find myself in substantial agreement with Professor Fitzgerald in the matter of Geography, its components and their nomenclature. Confessing first my own ignorance, I have long wondered what precise meaning was attached by some of my colleagues to the term Social Geography and have suggested, in a playful spirit only, that in any case the distribution of the term appeared to be of geographical interest in that it was chiefly favoured north-west of the Exe–Tees line. My own mistake arose through attempting to regard it as a subdivision of the same rank as Political or Economic Geography. As such it seemed a little precious. But as an altogether more fitting designation for what has been called "Human Geography," I welcome it and shall be glad to use it. Although the commonsense connotation of Human Geography is not in doubt, it suggests a false antithesis which modern Geography exists to deny. Whether or not a "pure" Physical Geography can exist in its own right beyond or athwart the conventional borders of geology, meteorology, and oceanography is a debatable question; a former London colleague of mine is said to have characterized such a subject as "a morbid futility." This is an opinion I cannot share, but I see the point at issue. Unless a pure Physical Geography can find justification as a background subject in the field of non-human biology it can be claimed as existing not alone, but as indissolubly linked or balanced with Social Geography. A Human (or Social) Geography with the geo- taken out or subordinated would similarly be a futility, if not a morbid futility, and at best a subject having little relation with Geography, however defined; it might perhaps be termed socio-anthropography. I feel no need of such a subject and nor I hope does Professor Fitzgerald.

Concerning Economic Geography I have long felt that grave confusion has arisen. The fact that the physical qualities and limitations of human habitats are related to the economies of human groups is one of the prime facts of Social Geography. In studying such relations one is not pursuing Economic Geography in any specialist sense, but just Geography, in its full and proper sense. But the large-scale operation of an exchange-economy, involving world-wide production and trade in commodities, does raise some special problems into which considerations of economic analysis enter. Robbins' well-known redefinition of Economics is as the study of "the forms assumed by human behaviour in the disposal of scarce means between alternative uses." On this basis Economic History is, or should be, "the explanation of the historical manifestations of scarcity" and we can at once add Economic Geography, the explanation of the corresponding geographical manifestations. This is perhaps a spare and abstract definition. But it clearly implies an understanding of the generalizations of economic analysis—of "marginalism." Such knowledge the generality of geographers do not possess and only those who do are equipped for the study of Economic Geography as a specialism. But such a study would be more justly entitled "Commercial Geography." S. W. WOOLDRIDGE.

26 *November* 1946.

As Professor Fitzgerald remarks, the recent questionnaire served "admirably the purpose it was designed to fulfil." Disputes about the categories of know-

ledge can be endless and are rarely profitable, for knowledge (like the world) is one. It is convenient in a rough-and-ready way to oppose Human and Physical Geography, while the particular aspects of the former to which students direct their attention—as Political, Economic, and now certainly Social—will become more numerous as our observation and discrimination become more acute. The most recent English writings on Historical Geography (by Darby, East, and others) indicate acceptance of the view that the historical geographer attempts a reconstruction and interpretation of the geography (both physical and human) of past periods. Travel and Exploration (the accumulation of observations) and Cartography (the symbolic representation and recording of appropriate categories of observations) allow also of historical treatment. The three distinctive aspects of our subject (or of any subject) are the observing, recording, and interpretation of the appropriate phenomena. For the listener to lectures the story of observations can be followed with the least intellectual effort. The reason why the professional geographer views the travel lecture with suspicion is the tacit assumption that a traveller is *ipso facto* a geographer, and that an untrained observer can contribute to geographical science. It is often useful to consider a question in its past rather than in its current context. Which was the geographer, Ptolemy of Alexandria, whose critical studies live to-day, or Septimus Flaccus whose military duties took him across the Sahara, and of whose name there is no record outside Ptolemy's pages? E. G. R. TAYLOR.

22 *November* 1946.

Professor Fitzgerald's letter will be welcome to all who wish to see the subject's scope and methods discussed. The paucity of methodological literature written by British geographers is revealed in Hartshorne's "The nature of Geography" (*Ann. Assoc. Am. Geogr.* 29 (1939) 171–658), and it is difficult to resist the impression that, while many workers in university schools have clear views on the nature of the subject, they are reluctant to transfer them to the printed page for criticism and discussion. Few could be sufficiently naïve to expect or even to desire agreement among the professional geographers of Britain, but many would like to know what they think. Therefore it is perhaps not unreasonable to suggest, first, that more attempts should be made to write methodological papers and, second, that more discussions on the content of Geography should be held at suitable meetings organized by such bodies as the Royal Geographical Society, Section E of the British Association, the Institute of British Geographers, and the Geographical Association. Moreover, it may be possible to establish two commissions that could do useful work: first, a commission to enquire into the present teaching, scope, and content of Geography in the Universities, not excluding its relation to other subjects, together with the fundamental philosophy of the subject held by its practitioners; and second, a commission charged with the compilation of a history of British Geography in its modern recrudescence. The latter is related to the former and is not less urgent, as many men and women who were the pioneers in the Universities and elsewhere are now coming to the stage of retirement and a few, including Dr Marion Newbigin, have died: their work, done in many cases under difficult and even at times hostile conditions, should be recorded.

The letter from Professor Fitzgerald shows very clearly that the terminology of courses is itself of significance: if we re-christen Human Geography "Social Geography," or, say, "the geography of humanity" or "the geography of society" or again (with an essential difference in meaning) of "societies," we can

hardly expect to mean the same thing. Every term has its disadvantages, every term a meaning that can be twisted into absurdity by the facetiously pedantic; it may be pertinent to enquire what we regard as belonging to this part of Geography. In the writer's experience, every course in Human Geography differs from every other, so that each may become the primrose path of academic dalliance which lecturers tread, no doubt eloquently, contemplating the human scene archaeologically, historically, anthropologically, politically, racially, economically, statistically, sociologically, and even morally, according to taste.

As we shall have to wait some time for the emergence of the type of University geography school envisaged by Professor Fleure, in which all the major branches of the subject and all the major regions of the world will have their specialist lecturers ('An introduction to Geography,' p. 36. London, 1929), it is perhaps desirable to ask where the centrality of the subject lies and what is circumferential. Have we, in fact, something to contribute to learning that no one else can give, or is the school of Geography the Autolycus of the University? If the regional approach permeates each course, then the real task of interpreting the landscape will be made possible: physical geography, climatology, biogeography, and the range of "human" teaching in all its social, economic, and political aspects will all draw material from the regional studies already achieved, and add strength to those in progress. No study should be condemned merely on the ground that it is circumferential, provided that it is of use in the ultimate Regional Geography that we wish to build; and this includes not only the regional geography of the present, but the regional geographies of the past.

T. W. FREEMAN.

23 *December* 1946.

UPPER BURMA 1943–44

I have seen Mr. Lambert's letter about my lecture to the Society on the above subject and I hastened to read the fascinating paper about his journeys between the Chindwin and the Brahmaputra to which he refers. I wish I had seen it before making my own journey; but although he says it was available in G.H.Q., India, I regret that I never saw it even during my time there as Lieutenant-Colonel Plans.

I was careful in my own paper to make it clear that, geographically speaking, my Brigade and I had nothing new to declare; and I did not mean to claim for one moment that we had broken completely new ground. At the very most, I thought perhaps we had covered short sections of new routes. Looking at Mr. Lambert's map, as he suggested, I observe that although his track crossed ours at two points—Hkalak Ga and Gum Ga—it does not appear to have coincided with ours except for a few miles north of Gum Ga. As to our having met Nagas who had not previously seen Europeans, we had only Kachin interpreters who happened to be among my Burma Rifles; but on two occasions Nagas whom we questioned said we were the first they had seen: once it was a party on the move between Hkalak Ga and Lulum Nok, and once near Tekti. Our mules also aroused great interest.

If Mr. Lambert can consult my book 'The wild green earth,' published in December 1946, he will find more details about our route than I was able to give in my paper. He will notice that we heard of a survey party which may have been his. Having seen the country, I am the more impressed with the magnitude of the achievement of Mr. Lambert and his companions, who had none of the facilities enjoyed by my companions and myself. BERNARD FERGUSSON.

14 *February* 1947.

THE SOURCES OF THE IRRAWADDY

Il s'agit de restituer au Colonel F. M. Bailey la découverte de la source principale de l'Irrawaddy qui m'a été attribuée publiquement à Londres à l'occasion du World Congress of Faiths (20–23 Septembre). Le programme portait à mon nom la mention "Discovered source of Irrawaddy." Sous cette forme exclusive l'information n'est pas exacte et elle pourrait être cause d'erreur au point de vue géographique car elle déterminerait quelle est la source principale de l'Irrawaddy.

J'avais en effet découvert la source orientale en 1909, soupçonnant, sans en avoir la preuve, qu'elle était le commencement de l'Irrawaddy (*La Géogr.* 23 (1911) 241–48). L'exploration que fit le Capitaine Bailey en 1911 confirma cette identification (*Geogr. J.* 39 (1912) 334–47; 'Le Tibet révolté,' Paris, 1912). Le Capitaine Bailey avait découvert une source plus occidentale, et cela avant de savoir que j'avais reconnu une source orientale.

Dans un livre récent ('China–Tibet–Assam. A journey, 1911,' London, 1945), le Colonel Bailey raconte ses souvenirs de voyage et revient plus longuement sur la question des sources de l'Irrawaddy. Il déplore de n'avoir pas eu alors connaissance de mon passage deux ans auparavant, de sorte qu'il n'eut pas l'attention attirée par la branche venant du nord-est. Pas plus d'ailleurs mon attention n'avait été attirée par la branche venant du nord-ouest (d'autant moins qu'en ce lieu même j'avais été arrêté par les Tibétains et de là refoulé vers la Chine). Ni l'un ni l'autre de nous deux n'avait comparé les deux rivières à leur confluent et chacun de nous a pensé être sur le cours principal de l'Irrawaddy.

Or c'est le Capitaine Bailey qui avait les plus justes raisons de s'y croire, car la branche nord-ouest qu'il suivait est dans le prolongement de la haute vallée principale qu'il venait de remonter en aval du confluent (vallée que j'avais descendue sur le même parcours). De plus, venant comme moi du bassin de la Salouen, lui seul passa ensuite dans celui du Brahmapoutre, ce qui m'avait été interdit. Il avait eu ainsi un élément d'appréciation en plus sur le cadre montagneux où l'Irrawaddy prend sa source. Enfin dix ans plus tard, le Capitaine F. Kingdon Ward a constaté qu'il y avait plus grand débit des cours d'eau venant de l'ouest que de ceux venant de l'est. Toutes ces raisons me portent à modifier complètement ma conviction première et à considérer comme source principale de l'Irrawaddy celle qui vient du Tsong-la et dont la découverte appartient au Colonel Bailey.

JACQUES BACOT.

Paris, le 9 Octobre 1946.

MEETINGS: SESSION 1946–47

First Meeting, 28 October 1946. The President in the Chair

Elections: H. Ainsworth; Captain Edmund Henry Buckingham Baker, R.N.; Charles James Bannerman, B.A.; Kenneth William Bennett; Major Roy Berry, R.E.; Miss Evelyn Marguerite Boake; Lieut.-Colonel E. L. Botting, R.E.; Ronald Edwin Bowyer; Miss Frances Margaret Branch; The Hon. M. S. Buckmaster; Meredith F. Burrill, M.A., PH.D.; Miss Jean Carter, B.A.; Mrs. Jane Cattell-Jones, B.A.; Commander John Miller Chaplin, R.N. Alan John Child; Sidney Gerald Chubb, B.COMM.; Rev. J. W. Clift; John Collings; Captain Hubert Roland Cooper, F.R.MET.SOC.; Christopher Gardner Croudace; Cresswell John Curtis; Harold John Davies, B.SC.; Tewdwr Griffith Bowen Davies; John Henry Reuben Davis; John Aloysius Delaney; Gerald Dillon; John Herbert Drayson; John Charles Elder; Rev. Hubert Entwisle; Richard William Feachem; Merton Fink; A. Mackie Frood; Richard Lawrence Gladstone; Lieut. Bryan G. Griffiths, R.E.; James Hair; Robert Aylmer Haldane; Francis George Hannell, B.SC.; Peter Hargreaves; Mark H. C. Hayler; Professor Sydney Ewart Hollingworth; Jack Kenneth Holt; Major James Barrie Hutton; Lieut.-Commander J. R. Langworthy, R.N.; Miss Anna Le Guillon; Rev. G. Irvin Lehman; Lieut.-Colonel Trevor David Lewis; James William Low; Miss Margery Low, M.D., M.R.C.P., D.P.M.; Charles Lyon-Maris; Miss Barbara Alice McKechnie; Alan John Marshall; Miss Jeanette E. Mason; Denis Owen Mathews; Mrs. Christabel Matthews; Miss Naomi Muriel Must, B.A.; Mrs. Elizabeth Niven; Robin Langford Oliver, M.SC.; John G. Peristiany; Roy Woodhouse Pocock, D.SC., F.G.S.; William George Ernest Porter; Brian Walter Preston-Littlewood; Lieut. John Quine, R.N.V.R.; Captain S. E. Reilly; Derrick Aylmer Hartley Russell; Mrs. Pamela Scott; Mrs. Bettie Smith, B.A.; Percy Adolphus Snell; Miss Cicely Eva Sopwith; Mrs. Emily Spink; Rev. J. Charles Sterne; Thomas Ralph Stobart, B.SC.; Eric Taylor, B.A.; Edward Thompson, O.B.E.; Kenneth Howard Towsey, M.A.; J. S. Turcan, M.C., B.A., A.M.I.C.E.; Clifford Warwick; Harry Wepfer; Kenneth Edwin Westman; Patrick Gerard White; Vernon E. White; Henry Herbert Williams; Miss Jocelyn Winfield, B.SC.; Ernest Wood-Johnson; John Wyse; Captain Henry de Carl Yarrington; Mrs. Hilda Byrne Young

Paper: Exercise "Muskox." By Lieut.-Colonel G. W. Rowley

Second Meeting, 4 November 1946

Geographical Films: Travels in Chile and Peru, with commentary by Mrs. Everild Young

Third Meeting, 11 November 1946. The President in the Chair

Paper: The industrialization of Oxford. By Mr. E. W. Gilbert

Fourth Meeting, 18 November 1946

Geographical Films: In occupied Japan, with commentary by Mr. William Courtenay

Fifth Meeting, 25 November 1946. The President in the Chair

Elections: Selwyn Herbert Arter; K. L. Hugh Bao; William Barry; George H. Beans; James Martin Birkbeck; Miss Elizabeth Marion Born; Wing Commander Robert Lawrence Bowes, D.F.C.; Robert Denis Bramwell, M.A.;

J. Bernard Buck, B.SC.; Lieut.-General Montague Brocas Burrows, C.B., D.S.O., M.C.; Orville Christian Carlson; Roger Castiglione, B.A.; Miss H. M. Collier; Percy John Cook; Stanley Coppins; Captain William Joyce Cowen, M.C.; Robert Cryan; Sq.-Leader John Frank Davis; Robert E. Dickinson, M.A., PH.D.; William Cecil Drodge; Michael M. Fidler; Fred William Foster, A.B., PH.D.; P. N. G. Godfrey; George Abernetley Alexander Grant; Arthur Guest; John C. Henton; Rev. John Philip Hilary Hobson, M.A.; William Holmes; Major Wilfrid Ronald Hough, B.A.; Gwilym T. J. Hughes; Graham Hunter; William Ernest Irving; Captain George A. Johns; Clifford Lloyd-Williams; Syed Abdul Majid, M.A.; Doctor Harold H. Mann; Frank Noel Marshall; Miss Mary Marshall, M.A.; Desmond Elliott Ledos Mathews; A. L. Mawdsley; Ian Robert Menzies; Ralph Francis Milner; Lieut. Edmond Morrison; Captain George W. Neely; Miss Dorothy Jean Peterken; Bertrand Eric Pleydell-Bouverie; John James Reed; William Frederick Rhodes; Lieut.-Colonel Denis Seymour Richard, M.B.E.; Captain John Salyer; Edwin Charles Sear, B.SC.; Sydney George Shepheard; Edward Arthur Skinner; Lieut.-Commander David John Campbell Smith, R.N.; Rev. Paul Brainerd Smith, B.A.; Major-General Robert Graham William Hawkins Stone, C.B., D.S.O., M.C.; M. J. Stonelake; Arthur Montfort Symns; Fl.-Lieut. Trevor Morgan Thomas, M.SC.; Major John D. Timpson, R. SIGS.; Oliver Jesse Tonks; Reuben Ibekwe Uzoma, B.A.; Miss Evelyn L. Walker; Oliver Cephas Wigmore; Lieut. Peter Morton Wilcockson, R.N.R.; John Harold Williams; Major Desmond Wilson, M.C.

Paper: Deep sea explorations in the Mediterranean. By Professor Hans Pettersson

Sixth Meeting, 4 December 1946. The President in the Chair

Paper: Richard Hakluyt. By Professor E. G. R. Taylor

Seventh Meeting, 9 December 1946. The President in the Chair

Paper: Some geographical factors in the Palestine problem. By Dr. E. C. Willatts

Eighth Meeting, 16 December 1946. The President in the Chair

Elections: Mohamed Mahmoud Al Sayyad, M.A.; William C. Attwater; Joseph Whieldon Barks, B.A.; Henry Bloomfield; Wallace Kenneth Buckingham; Colin Jennison Cawthorn; Neil Corbett; W. Leon Dale, M.B.E.; Donald Wilfred Fryer, M.SC.; Kenneth Gardner; Major Francis Sidney Cunningham Hancock; Walter Brian Harland, M.A.; Charles M. Harris; Lieut. Richard Stephen Inglis Hawkins, R.N.; Frederick Bedrich Hermann; Harold Hill, F.R.C.S.; Thomas Howard; Herbert Martin Jefferys; Lady Kathleen Kennet; Major Ronald Stuart Kinsey; Albert A. Leaf; Paul Marks; Dennis William Martin; John Frederick Mitchell-Hedges; Miss Martha Moennich; Captain John P. Nash; Henry Frederick Overy; Major Jack K. Rashleigh; Rev. Alan Frederic Clifford Rowe; Captain the Rt. Hon. Lord Saltoun of Abernethy, M.C.; Sq. Leader Raymond D. Sheerdown, O.B.E.; Stanley Capel Sparling; Henry Gordon Stokes; Gerald V. Summerhayes; Andrew Thomson; Horatio Herbert Kitchener Thomson; Rev. Garfield E. Vale; Frederick Willaim Charles Winter, B.SC.; Stanley Thomas Wood, M.A.

Paper: Travels in Japanese-occupied Malaya. By Mr. F. Spencer-Chapman

Christmas Meetings. 23 December 1946: Beneath the trees. Films and commentary by Mr. John Chear. 30 December 1946: Life in an igloo. By Mrs. Tom Manning

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